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The Season's Wishes

WHILE engineers are generally not credited with being sentimental, and while sentiment is taboo in the pages of a technical journal, the Engineering Record cannot resist the impulse, on the approach of the holiday season, to speak freely its mind. It extends to its readers, therefore, a hearty Christmas greeting, with the hope that the joys may be tempered by no sorrow, that the "peace which surpasseth all understanding" may prevail, and that the greatest of the Christmas pleasures may be the contemplation of a future holding greater and more inspiring tasks and filling each with enthusiasm and strength for his chosen work.

Financial Signs Continue Hopeful

LAST week attention was called to the resumption of trading on the New York Stock Exchange in a selected list of stocks. Such was the demand and so clear the indication of returned confidence and of freedom from the danger of panicky conditions that within three days the market was broadened to take in the entire list of exchange stocks. While the stock exchange is not the only index of business conditions, nor always the most certain, it does reflect quite closely the sum total of all the factors affecting the commercial status of the country. The confident tone displayed, therefore, taken with other unmistakable signs of improved conditions, warrants a continuance of and even increase in the hopeful sentiment of the past month.

Flood Control in China

WITH the submission of the report of the board of engineers—William L. Sibert, Daniel W. Mead and Arthur P. Davis—appointed by the American National Red Cross, the first step has been taken in the solution of the flood problem in China. The board visited the Orient last summer and as a result of its findings, published in abstract on page 679, it recommends a river improvement project which will cost $30,000,000 and require 6 years to complete. For years past the Huai River, the Yellow and other streams in China have periodically overflowed their banks or shifted their courses with the result that there has been appalling loss of life and property. When the proposed improvements are completed this destruction will be very largely eliminated and the benefits in the improved and reclaimed lands will more than pay the cost of the work. There is something of romance about the project, for it represents the solution of the stranger for a problem with which the native has wrestled unsuccessfully for ten centuries. America will live in hopes that it may be put through, not that it may result in a triumph for Western genius where Eastern efforts have failed, but that it may bring to a distracted district the freedom from disaster, privation and disease which will follow the control of the waters.

Making Road Funds "Go"

IT would be difficult to place undue emphasis upon the points made in the article in last week's issue of the Engineering Record on "Expenditures for Permanent and Perishable Features of Roads." The economic crime involved in issuing long term bonds to pay for short-lived roads has been the subject of frequent comment in these pages. We now have, thanks to the investigations of the Office of Public Roads, a fairly satisfactory formula for arriving at the proportion of permanent and perishable features of roads of various types. As an example, for plain macadam it is estimated that 62 per cent of the total expenditure should go into permanent features, namely, grading, alignment, foundations and structures. Rarely is this proportion of available funds so spent because of the pressure to "make the money go as far as possible." And go it does, never to return, while if adequate attention is paid to permanent features there may be a smaller mileage of road with costly surfaces but there will at least be something to show for the money even at the expiration of a long-term bond.

Employing the Unemployed

EMPLOYERS in Chicago are being urged to make a strenuous effort to keep as many men as possible on their payrolls. The idea grew out of an address to the Cook County Real Estate Board by Senator Cummins of Iowa, who made a strong plea for the addition to every payroll of one more man or woman as a definite aid to the solution of the unemployment problem. The idea has merit from the points of view of charity and humanity, but as this journal has often pointed out, there is grave danger of decreasing the morale of a whole organization if men are added for whom there is not enough to do. The passing out of public funds in the form of full salaries to men who long since should have been on the pension roll, and the making of appropriations for unnecessary or untimely public works, come under the same class of questionable procedure. On the other hand, the present is an excellent time to let contracts for needed improvements. Cities with credit, as well as private interests, should realize that especially low figures are now being made for materials. Contracts for factory buildings and enlargements have recently been closed, according to the statement of a prominent Chicago engineer and architect, at from 20 to 40 per cent decrease over last year's prices. Many a contractor has pared down his force to his best picked men, who form the nucleus which in affluent times he can expand to almost any dimension. To keep these men together contractors must have work and in consequence are bidding low. The legitimate enterprise should go ahead but technical advice should be secured in advance to make sure that the improvement is required.

Discretionary Powers

A RECENT Illinois decision of interest to engineers involves the right of a building commissioner to refuse to stop work on a structure in which the building code is being violated. To the layman, no case would seem to be clearer. The ordinance specifically stated that work should be stopped if the evidence of violation of the code were indisputable, yet building commissioners have held that this gave discretionary powers and that they were free to allow the work to continue. In the case in question it was attempted to compel the building commissioner to stop work which violated the code. The lower court decided for the prosecution and, on appeal, the Appellate Court confirmed the finding. The commissioner admitted the violations but claimed discretionary power. The decision, confirming the strict construction of the law, now leaves him no recourse. If there is violation the work must be stopped. While, as before stated, the result would seem to the layman to have been obvious and the court's decision a matter of course, it is worthy of the attention of engineers because it stiffens the backbone of commissioners against the building committees of city councils, and politicians generally, who not infrequently ask for modifications of building regulations. For this one result alone, the Illinois contest and the decision are well worth the trouble of adjudicating the matter.

A Pipe Line without a Precedent

SUBMARINE work is generally productive of novel and interesting methods of construction. This is particularly true of the Narrows flexible-joint siphon of the Catskill aqueduct, described by John P. Hogan, on page 656. The problem was to deliver a portion of New York City's Catskill water supply from Brooklyn to Staten Island across the Narrows, or channel connecting the upper and lower New York bays. The possible solutions were a tunnel and a submerged pipe line, and the latter plan was adopted. The line, a portion of which has already been laid, is made up of 12-ft. sections of 36-in. cast-iron pipe with a specially designed flexible joint. The distance from shore to shore is about 10,000 ft. and the path of the line extends across the congested lanes of shipping traffic to and from the port of New York. The depth of water in some places is as great as 74 ft., and with strong tidal currents to be resisted in maintaining floating equipment in a stationary position, to say nothing of the precautions for avoiding collisions with passing ships, it is obvious that there were few if any precedents to guide the contractors in performing the work. A good idea of the general scheme adopted may be had from an examination of the picture on the front cover of this issue. From a large scow a 60-ton structural steel cradle, 180 ft. long, extends to the harbor bottom, and from this inclined skidway the pipe slides into place. The joint itself, a modification of the Duane joint, is the result of long study and experiment. It was found by test that the pouring of hot lead into the joint would not secure the desired degree of watertightness and a scheme was evolved for filling any spaces left after the hot pouring with cold lead pellets forced through gib-screw holes in the pipe by means of air tools. The dredging was done with a 6½-cu. yd. manganese steel bucket weighing 13 tons. The unusual depth at which this work was performed makes it an important feature of the contract. The problem of testing the pipe for watertightness was one of the incidents in the work. Mr. Hogan describes the ingenious apparatus which was developed for this purpose and tells of some of the difficulties encountered before a satisfactory test was made. The Catskill aqueduct work has produced a plentiful supply of bold and novel structures but none of them exceeds in interest the Narrows siphon.

The Edison Fire

JUDGING by the letters received by this journal no occurrence involving engineering structures has in recent years attracted so much attention as the fire which on Dec. 9 destroyed the major part of the plant of Thomas A. Edison, Inc., at West Orange, N. J. This attention was due to the sensational character of the newspaper reports regarding the behavior of the concrete structures. The impression was given that they had failed completely. The letters received expressed doubt as to the accuracy of the reports and asked for full information. An account of the fire and of its effects will be found on page 660.

While chief interest would seem to center in the performance of the concrete buildings, the most important conclusion is a costly verification of one of the fundamentals of fire protection practice. This conclusion should be preached from the housetops—that when structures are exposed to fire hazard from without it is folly to place one's trust in "fireproof" buildings fitted with wooden window sash and plain glass. The ruin at West Orange, thrown in relief by being linked with the great inventor's name, preaches that lesson to the matter-of-fact plant executive more strongly than all the fire-prevention documents ever written. Here was a plant with closely spaced buildings, all of them without the fire-protection provisions which long experience has demonstrated to be essential for the safeguarding of such structures. Moreover, there were no fire walls to prevent the spread of the flames from one adjoining building to the next, and none of the buildings were equipped with automatic sprinklers. The concrete buildings were considered "fireproof," but can be called so only by courtesy. They were not fireproof, except in the sense that they themselves would not burn. They were virtually concrete stoves, with tinder at every window inviting the application of the torch.

As for the performance of the concrete buildings in so severe a test, one can happily report that they came through very well. It is safe to say that four of the seven are in their entirety usable. In two of the remaining buildings the damage is local, affecting parts of four floors, while in the third the columns in the first floor are in very bad condition.

Of interesting questions raised by the fire there are many. Two are especially pertinent. Was the failure to use ties or hooping around the reinforcing responsible for the damage to columns where the fire was unusually hot, as, for example, in the basement of building 11, where the expansion of the rods seems to have forced off the column corners? Are the severity and duration of the fire sufficient to account for the column damage in certain sections or is the theory, advanced by the plant officials, that their failure was due to the water thrown on them while hot necessary to account for the destruction? These questions are open to argument, but as to the second the Engineering Record believes that the water played a critical rôle. Without this conclusion the strange localization of the column failures seems inexplicable, for there is reason to believe that there was very intense heat elsewhere than in the sections suffering maximum damage.

It will be natural to use the disaster for making comparisons between different types of construction, and opinions as to the efficiency of the concrete structures under such conditions will likely be influenced by prejudices for or against this type. To the Engineering Record, however, certain conclusions, based on alternative premises, seem evident. If the untied column rods played an important part in the failures, other fireproofed types may have come through just as well. If water was the chief factor, then any other type than concrete, under the conditions which obtained in the ground floor of building 11, in the southeast corner of the same structure, and in the third floor of building 24, would have been on the ground, with a very much larger contents loss than is the case at West Orange. Of course the failure in 24 might have been confined to the west wing, and that in the corner of 11 to the particular section in question.

Regardless of these views or those others may hold, all can agree that no structure, no matter what the type, should be called upon to meet such a test. The fundamental question is not as to the type that makes the best stove for inflammable contents, but what methods will prevent the spread of the flames. Fire-resisting window and door construction, fire walls and, above all, sprinklers furnish the answer.

Boston Street Lighting Contract

A STREET lighting contract with several interesting provisions has been signed by the mayor of Boston and the Edison Electric Illuminating Company of that city, concluding negotiations covering several months. About 4500 magnetite arc lamps now light the main streets of Boston proper, while a large number of series incandescents are used on minor thoroughfares, with a few high-powered flaming arcs in the public squares. The terms of renewal, price of service and provision for taking advantage of future progress in equipment design received a great deal of discussion in the city council, and the way in which the matter finally has been worked out does credit to the representatives of both parties.

The company desired a ten-year contract, conforming to its street lighting agreements in many other municipalities in eastern Massachusetts, and after long and persuasive effort this term was granted, with the proviso, however, that at the end of five years the prices shall be reviewed by the Massachusetts Gas and Electric Light Commission and changed if the board so determines. By this plan the city escapes being tied to a rigid price through a period considered long by the opponents of long-term contracts, while the company is relieved of anxiety concerning its street lighting investment and enjoys the fullest opportunity to present data and arguments to establish a fair rate of return in case of a disposition to assail its revenues. The benefits of a stable but flexible relationship are thus assured both parties.

The prices mentioned in the contract are in accordance with one of the company's regular schedules, but as the city authorities sought as low terms as possible, both parties agreed to submit the determination of the rate immediately to the Gas and Electric Light Commission, which will ascertain if the prices named should be lowered for the first 5-year period. This method of settlement was a decided concession on the part of the company, which is likely to be called upon to support its existing schedule by comprehensive figures, although the certainty of a thorough hearing on the merits of the case makes the concession less than at first sight appears. In this connection it is interesting to note a provision whereby the commissioner of public works may require the company to furnish a yearly statement of the cost of supplying the service, including interest and depreciation, in such form and in such detail as may be called for. Again, the contract provides that if lamps of other types are substituted, the fixed costs per lamp shall be the same as at present, while the running costs shall be determined by agreement between the commissioner and the company, subject to arbitration if necessary.

In setting forth rates upon the fixed and running cost basis, recognition is given in the contract to the best thought of engineering economies, which insists upon the separation of overhead charges from operating expenses wherever possible. Careful provision has been made, also, for such matters as the meeting of the cost of improvements, the sharing of their benefits between city and company, the exact definition of how "outages" shall be measured, discontinuance of service on abandoned streets, extensions of the present overhead and underground systems, testing, and other points. The description of lamps in terms of mean horizontal candlepower for incandescents and mean hemispherical candlepower for arcs of stated wattage is a feature worth imitating.

Altogether the executive authorities of the city and of the company seem to have produced a thoroughly workable agreement, which bears no less evidence of engineering insight than of legal skill, and which provides a starting point for certain further analyses of the cost of city street lighting which should be of much technical interest.

The Evils of Indefinite Plans and Specifications

ADVOCACY of definite plans and specifications on either public or private work is no longer necessary. In theory it is recognized as desirable to give contractors all the information possible when asking for bids. Quantities should be as definite as possible, and alternative designs permitted only after careful consideration. If alternative plans are permitted, the restrictions should be such that it is possible to compare them.

While this is the theory, contractors cite instances without number of its violation in practice. Two very recent examples in neighboring cities furnish food for thought for those whose invitations to bidders are still indefinite. In the one case tenders were asked for the construction of a $300,000 sewer system. The contract form contained 55 pages of text, covering terms and conditions of the contract and the grade of materials and work required. Then followed a 15-page list of detailed quantities. This list did not attempt to show the amount of cement required, for example, but rather the number of cubic yards of concrete in each different sewer section per lineal foot. It enumerated the exact length of each type and size of section for various depths and the amount of excavation, timbering and invert paving required on curves and tangents. Quantities in cubic yards were carried out to the third decimal place, and even the exact number of step-irons and their bolts was listed. Opposite each of the items listed there was left a blank in which the contractor was to fill in unit and total prices.

In marked contrast to this it is interesting to note that some time after tenders were asked for this sewer work a neighboring city called for bids on a reinforced-concrete structure for municipal use. There was some debate as to just what type of construction to adopt, so it was decided to leave the specifications somewhat indefinite and allow each bidder to submit his own design. When bids were opened it was found that twelve contractors had turned in a total of one hundred and twenty different tenders, each one for a different design, and all based on estimates which could not possibly have been worked out in fine detail. These tenders varied from $162,000 to $248,000 and, partially because it was impossible to compare them satisfactorily, no final action has yet been taken.

The sewer work, on the other hand, has been under way for several months, the contract having been awarded shortly after bids were opened. After eliminating the highest and the lowest bidders in the sewer work the remaining five tenders were within 12 per cent of one another, and no one varied more than 7 per cent from the engineer's estimate.

There will be some criticism of the refinement in the case of the sewer specifications where preliminary calculations worked out concrete yardages per foot to the last thousandth, but such criticism only accentuates the moral in the comparison, for even with this extreme refinement the cost of getting out the specifications was only about one-tenth of 1 per cent of the work.

The Training of the Civil Engineer

ADVOCACY of the introduction of a larger percentage of liberal studies in engineering courses is not infrequent, yet progress in this direction has been slow. It is all the more interesting, therefore, to examine the curriculum of an institution which has put into practice the liberalization so frequently advocated.

Speaking broadly, the engineering courses at Johns Hopkins University have been developed on the theory that engineering, in whatever branch, is a profession and not a trade, a vocation which requires not only technical skill, but a trained mind. To emphasize the effect of such a requirement on the development of engineering courses Prof. C. J. Tilden of that university, in a recent paper, shows in charts the composition of the courses in the four undergraduate years of the engineering department, and also a comparison of the course there worked out with the courses in five other well known institutions.

He divides, for convenience, the various courses into three classes: purely cultural, like English, modern languages, political economy; scientific preparatory, such as mathematics, physics and geology, and, finally, the professional subjects which have to do with the technical work of engineers. These graphs are very striking in showing the importance attached to general training, both cultural and scientific, as a basis for professional work. The first two years of the course are, except for one short summer course in surveying, given over wholly to general training. In the third year the foundations are laid for the technical engineering courses, which then begin to assume considerable importance and in the fourth year take the major portion, but by no means all, of the time.

Comparing the course with those in the other engineering schools, considered as an average, the Baltimore curriculum gives more than twice as much time to the cultural studies, 10 per cent more to the sciences which underlie technology, and about two-thirds as much to purely professional studies. These differences are striking and hopeful. When one comes to realize, as does the engineer long in practice, the extreme specialization that has fallen upon the engineering profession and rent it, he must see clearly that if the student is to be of any use outside a very narrow line of progress he must have a wider horizon at the start than is ordinarily his fortune to secure in the engineering schools. As he goes on he will of necessity plunge into the canyons of specialization, so to speak, and unless he knows something of the general topography of science he will never be able to climb out of them or come to their end.

The problem before the engineering school is to take a boy at perhaps the age of eighteen, having had a more or less imperfect fitting in schools which are usually more concerned with the manner of teaching than with the vitality of the things taught, and give him a fair start in his profession in four academic years. Now the solemn fact of the matter is that you cannot take even a particularly clever young man with the average secondary-school training and make an engineer out of him in four years. It is like trying to crowd a quart into a pint bottle. There are only two procedures open: one to jam all the so-called professional training possible into the time available and trust to luck for the results, the other to teach the student first how to attack the problem of giving himself a professional training, and to put him in possession of the means of acquiring it either by his own efforts or by post-graduate study. If by his last year of undergraduate work he can be given a thorough foundation and a fair start in the strictly technical portion of his chosen profession, he is in a position to learn quickly either in the post-graduate school or the field, and there is every reason to expect that in five years' time he will have gone well ahead of the man who has been stuffed with facts as they stuff geese in Strassburg.

The bane of engineering courses in this country has been the very temptation to which Professor Tilden refers in his paper, an obsession that "the student should have this" or "should be given that," with the result that in some universities the unfortunate victim may be taking ten or twelve technical courses simultaneously, acquiring little dabs of this, that and the other at the expense of well directed mental effort in anything. Johns Hopkins should be congratulated on having made up its mind that those things which are worth doing at all are worth doing well in the matter of engineering studies. In this it is in fact merely following out the great traditions of the university, for if there is any one thing which has stood out preeminently in its history, it has been the capacity of doing things thoroughly.

The Narrows Flexible Joint Submarine Siphon

Unusual Floating Plant and 60-Ton Steel Cradle, Difficult Dredging in Deep Water, and Special Joint are Features of 36-Inch Catskill Water Supply Line Across New York Bay

By JOHN P. HOGAN
Division Engineer, New York Board of Water Supply

TEN fathoms below mean sea level there is being laid in a dredged trench across the congested lanes of shipping traffic in New York Bay a 36-in. flexible joint pipe line, 10,000 ft. long, which will carry the Catskill water supply for New York City across the Narrows from Brooklyn to Staten Island. Of the many features which make the work different from anything along similar lines ever attempted a few may be enumerated: An elaborate floating plant, consisting essentially of a scow and a huge, curved structural steel cradle or skidway extending to the harbor bottom and weighing 60 tons, is employed for placing the pipe. The jointing with molten lead—300 lb. to a joint—is done at the surface and as successive lengths of pipe are added to the line the scow is pulled forward, allowing the pipe to slide down the cradle and into place in the dredged trench. Strong tidal currents have to be taken into account in mooring the scow. The ever-present danger of a collision with an ocean liner must be carefully guarded against. After long experimental investigation a special type of joint has been developed; it is made watertight, after the hot lead pouring is completed, by forcing in cold lead pellets with air drills. The dredging of 600,000 cu. yd. of material at a great depth—74 ft. in one section of the line—was only one of the incidents in the construction program. Obviously the line must be tested for watertightness and ingenious apparatus was designed for this purpose.

DEPTH AT CROSSING

At the northerly limit of the Narrows, where the crossing is made, the minimum depth of water is about 27 ft. and there are two ship channels—the Bay Ridge channel, with an average depth of 45 ft., and the main ship channel with a maximum depth of 60 ft. Through these two channels passes almost the entire commerce of New York City, and on both sides are anchorage grounds. The maximum rise and fall of tide is about 8 ft. and the maximum tidal velocity 3½ miles per hour. Government regulations and the desire to provide a protective covering for the conduit require that it be at least 59 ft. below mean sea level.

A flexible joint line was decided on, and in order to avoid under-water work the Duane joint was modified in an interesting and novel manner. A description of the modified joint and of the preliminary experiments leading to its adoption was contained in the Engineering Record of Sept. 20, 1913, page 317. Instead of calking the face of the joint under water by divers the joint was to be calked on the surface by forcing in lead pellets through sixteen holes equally spaced around the bell and fitted with gib screws.

FLEXIBLE JOINT EXPERIMENTS

After the contract was awarded further experiments were conducted to determine any weakness in the proposed joint and improve it. These experiments developed that the proposed joint was deficient in lead; that its apparent tightness had been partially due to a liberal use of grease and graphite; that the joint was deficient in the longitudinal strength necessary to withstand laying and temperature stresses; and that in its present form it could be improved but not perfected. Various changes in the position of the gib screws (for forcing in cold lead pellets) and the middle stop or ridge on the spigot were then tried, and finally a second row of gib screws was added. The amount of lead which could be injected through the gib screw holes without destroying flexibility was thus increased from 8 to 22 lb., and a joint was developed which was not only tight, flexible and strong longitudinally, but which would stand an almost incredible amount of abuse. The preliminary design and the final joint are shown in the drawings. About 300 lb. of lead are used in pouring the joint and the lead forced in cold consists of cylindrical pellets 9/16 in. in diameter by 1¾ in. long. Three pellets are forced in each of the back holes, three in each of the front holes, and then one in each of the back holes. A mixture of grease with about 10 per cent graphite is forced in each hole and they are then plugged with tap bolts and lead washers.

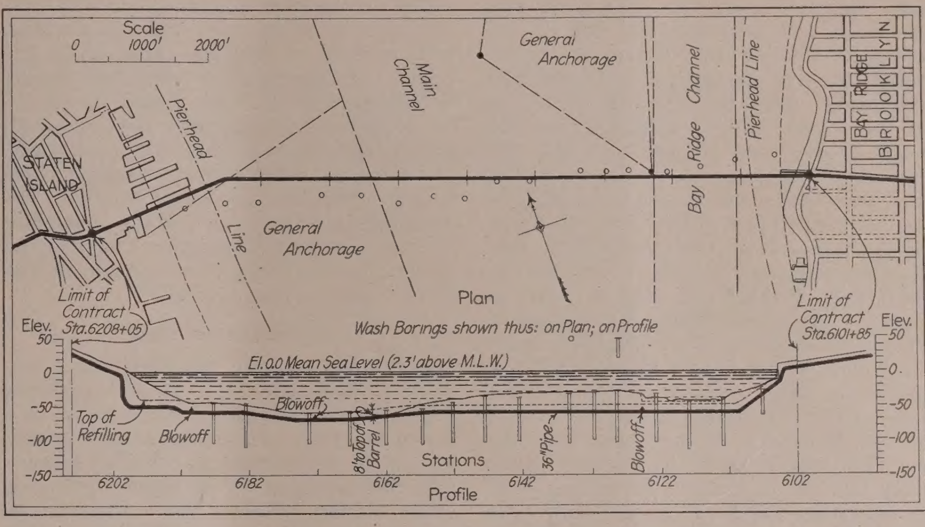
Twenty-seven separate experiments including elaborate strength and leakage tests were made and these extended over a period of about three months. During all these experiments efforts were made to develop mechanical means for forcing in the lead, which became the more important as the quantity of lead increased. In the original experiments the lead pellets had been forced in by gib screws turned by hand. Air drills for forcing in and backing out the gib screws proved a distinct improvement. Hydraulic plungers operating directly against the lead were then tried and cut the actual time of forcing in the entire 22 lb. of lead to about half an hour after the plungers had been rigged up. But the rigging was so slow and the connections under 700 lb. pressure gave so much trouble that much of the gain was lost. Finally an ingenious carriage with four Ingersoll-Rand "Little David" air drills was developed which revolved around the band and permitted the simultaneous use of the four drills and quick adjustment. This reduced the gross time of the entire operation of calking to an hour and was adopted and used in the work.

PIPE-LAYING CRADLE

During these experiments the preparation of the pipe-laying apparatus was completed. The contract specified that the pipe should be laid by the continuous process, using a cradle or skidway, and that the deflection per joint during laying should not exceed 5 deg. The contractor accordingly constructed a structural steel cradle resembling a through-truss bridge, curved in a vertical plane. This is composed of 14 panels each 12 ft. long (equal to the length of one pipe) and with a 5-deg. angle between each panel. It is 180 ft. long 8 ft. wide and 10 ft. high and weighs nearly 60 tons. The pipe is held in place on the cradle by three guides, one at the bottom and one on each side. This cradle is supported by cables on a trunnion cantilevered over the front of the pipe scow. The latter measures 40 ft. wide by 125 ft. long, is held in position by ten anchors and carries a 70-ton derrick. Each cable is led to a power operated drum. Due to shallow water at the start it was impossible to carry the cradle from the bow as the pipe-laying scow could not be moored over the cradle. The latter was accordingly supported over the side of the scow by the derrick. The pipe-laying scow and cradle are shown in the drawings and photographs.

MOVING SCOW

While pouring a joint and forcing in the lead pellets the pipe is held fast to the skidway by cables. When ready to move ahead the pipe is supported by the derrick and the cables attaching it to the skidway



PLAN AND PROFILE OF SUBMERGED PIPE LINE ACROSS THE NARROWS

are removed. A sufficient pull is kept on the pipe to support the suspended weight and thus keep it from crowding down on the pipe at the bottom of the cradle and forcing it out of line. If this pull be too great it will tend to straighten out the suspended pipe and lift it off the skidway. All is then ready for the move. A man then takes his place on the top of the skidway in the center and, lining in with the shore ranges, directs the move. The rear cables are slackened and the forward cables wound in, thus moving the scow ahead slowly and allowing the pipe to slide gently down the skidway. The direction can be closely controlled as each of the cables has its own separate power drum.

The average time of making a joint and lowering a 12-ft. length complete is about 3 hours, distributed as follows: Setting pipe, 20 min; pouring joint, etc., 20 min; forcing in pellets, 60 min; moving ahead, 20 min; average time lost through breaking gib screws, delays in moving, etc., 60 min; total, 180 min.

The average number of joints laid per 8-hour shift is thus about 2½. This does not include delays on account of weather conditions, or other contingencies. The minimum time of making up a joint and lowering a length is 1½ hours. The maximum number of pipe laid on any shift is 5. The average force employed on the pipe scow per 8-hour shift is 25 men. This does not include the force employed on the various auxiliaries, transporting men, materials and supplies, and moving anchors, etc.

MANUFACTURE OF PIPE

The pipe is manufactured by the Westinghouse Machine Company of East Pittsburgh, Pa. The machine work is of a high grade, particularly in the bell, where the allowance for variation from true sphericity is only 0.01 in., although a variation of ⅛ inch in diameter is permitted. In order that the pipe may be flexed freely without damaging the lead joint the interior of the bell is as smooth as it is possible to get it. Three machine cuts are taken from the rough casting and the bell is then ground, using a 14-in. wheel on a flexible shaft. The bare operation of grinding each bell consumes from 5 to 6 hours machine time. The casting of the pipe is also rather more difficult than usual because the machining discloses all blow holes in the bell and because the spigot end must be cut off at a fixed point and therefore no opportunity is given to shorten a spongy end; a practice generally permitted with a limited number of castings on ordinary pipe work.

PROTECTIVE PIPE COATING

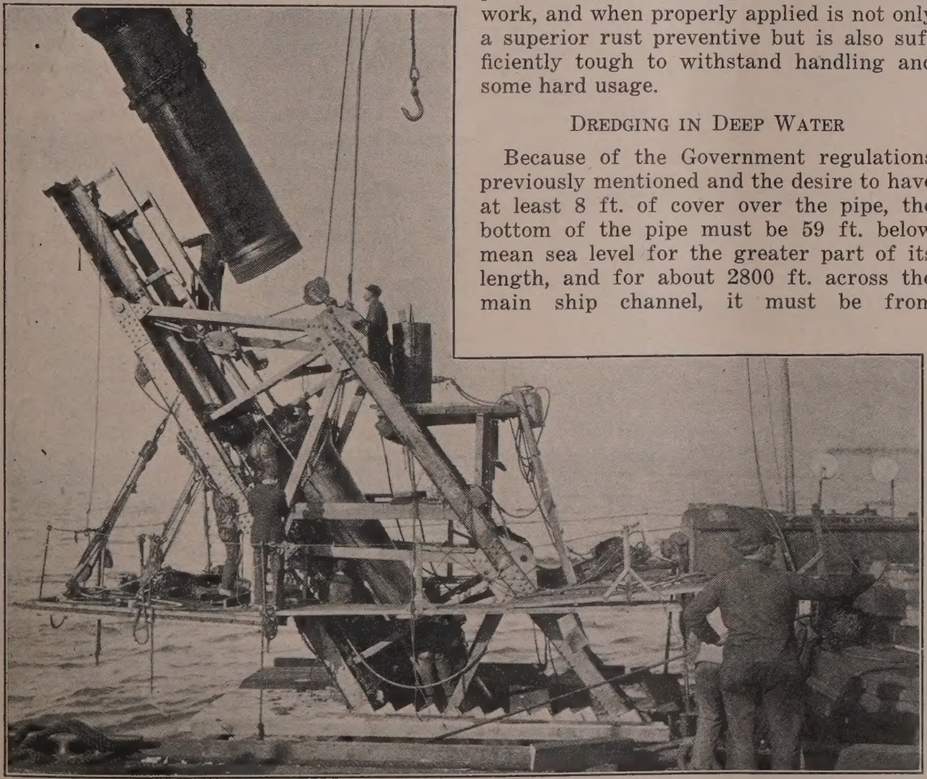
The entire pipe is coated inside and out at the shops with a protective coat of Bitumastic solution applied by the American Bitumastic Enamels Company. On its arrival at the work a second coat of solution and a coat of Bitumastic enamel is applied. This is a proprietary coating which has been used for a number of years in inaccessible places in the hulls of ships and other marine work, and when properly applied is not only a superior rust preventive but is also sufficiently tough to withstand handling and some hard usage.

DREDGING IN DEEP WATER

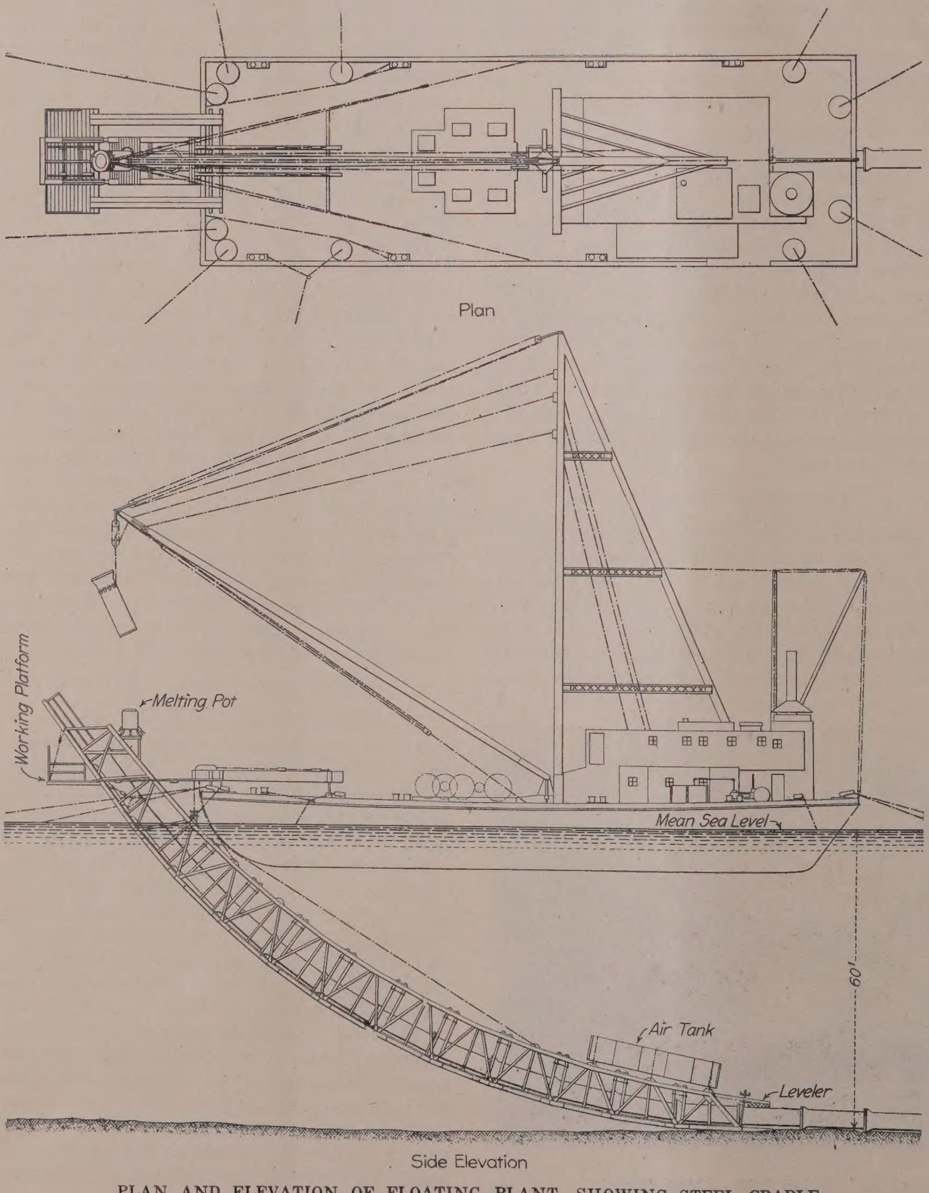
Because of the Government regulations previously mentioned and the desire to have at least 8 ft. of cover over the pipe, the bottom of the pipe must be 59 ft. below mean sea level for the greater part of its length, and for about 2800 ft. across the main ship channel, it must be from 59 to 74 ft. under water. The necessary cut varies from 10 to 35 ft., and the total amount of dredging is estimated at about 600,000 cu. yd. An effort has been made to get a trench of the minimum section which would remain open during the interval of from 1 to 2 months which must elapse between dredging and pipe laying. At first the trench was dredged to a bottom width of 20 ft. with slopes as steep as they would stand. In order to determine this slope the trench was gone over three times at some places. It was found, however, that these slopes were no longer stable when affected by the eddies set up by the pipe laying scow and skidway. These eddies carried the light mud from the top edge into the trench, sometimes filling it to a depth of 10 ft. While no difficulty was experienced in pulling the skidway through this mud, it prevented divers from examining the pipe. The pipe went down through the mud to hard bottom, but the skidway did not go all the way down, and the last pipe off the skid was thus subjected to maximum deflection which was not thought desirable. The width of the bottom of the trench was therefore increased to 40 ft. with side slopes depending on the character of the material, but slightly flatter than the slope necessary for mere stability. The greater part of the dredging is in the middle ground where the material is fine to superfine sand and the cut ranges from 25 to 35 ft. Here the trench is 40 ft. wide on the bottom with an average side slope of about 2 on 1.

TROUBLE FROM TIDAL CURRENTS

The difficulties of the dredging on account of the extreme depth and narrowness of the trench were further complicated by the location of the trench at right angles to the strong tidal currents which made it impossible to dredge along the centerline. The dredge had to be moored with the current and dig across the trench. The depth of 60 ft. or more made it impossible to use a ladder or dipper-dredge, and even the use of poles to guide the bucket was impossible. The bucket was frequently carried 15 or 20 ft. out of line by the tide. These factors all made it difficult to keep to accurate alignment or grade. Soundings can only be made at slack water, and neither the location nor depth of the soundings are sufficiently accurate to serve as other than a general guide. In short, the soundings determine



LOWERING PIPE UPON CRADLE PREPARATORY TO POURING LEAD JOINT that a trench of about the right depth, size and shape has been dredged, but do not determine whether the bottom is smooth enough to give the pipe a good bed and even grade. After the first 1000 ft. of pipe had been laid, it was apparent that the bucket dredge used did not leave the bottom smooth enough. A small amount of work was then done by divers with jets, but this method proved slow and expensive. An A-shaped drag was accordingly constructed, composed of two 24-in. 100 lb. I-beams, 25 ft. long and 19½ ft. apart at the base with one 12-in. 40-lb. channel cross-brace at the base. A 15/16-in. plate, 3 to 5 ft. in width, is riveted to the top and bottom of each member, and the lower plate on the cross-brace is inclined toward the apex to make a cutting edge. The total weight is over 10 tons. The drag is slung under the rear of a scow, the pulling cable passing from the front of the scow to a U-bolt at the apex of the drag. Each side of the rear end of the drag is connected by a cable to a differential block hanging from a frame over the stern of the scow, thus making it possible to regulate the depth of the drag. The scow is towed by a tug on center line with a tug on each side to keep it in line. Dragging is done at slack water, and five or six movements of the drag have been sufficient to smooth off the bottom in sandy material.



PLAN AND ELEVATION OF FLOATING PLANT, SHOWING STEEL CRADLE

The dredge used is of the clamshell type. The scow is 40 ft. wide and 120 ft. long, with engines of 500 hp. capacity at 125 r.p.m. A hard-bottom clamshell bucket weighing 26,000 lb. with a capacity of 6½ cu. yd. is used for the most part, although a mud bucket has been in use occasionally. The average daily output, working three 8-hour shifts, has been about 3800 yd. The dredging is being done for the contractor by the Coastwise Dredging Company, of which Fred E. Jones is vice-president and J. G. Trent, superintendent.

Hydrostatic Test

When the contract was prepared it was realized that as the type of joint proposed had never been tried in the field or subjected to laying stresses there was a certain amount of doubt as to its complete success, and the necessity of resorting to underwater calking by divers was considered. It was accordingly provided that before 2000 ft. of pipe had been laid, a hydrostatic test of the line should be made at a pressure of 130 lb. to the square inch. If this test should prove a failure it was possible to order general submarine calking under an item of the contract which, in turn, entailed a guarantee by the contractor of the tightness of the line within certain limits (about 5 gal. per day per foot of pipe).

It was not possible to make this test by the simple method of fastening bulkheads on both sides of the line, because one end of the pipe was afloat and it was not considered desirable to bring the tension of 110 tons, caused by a pressure of 130 lb. per square inch, on the joints. It was also thought inadvisable to subject the pipe on the skidway to the test pressure, since the skidway was designed for an empty pipe or a live load of about 1 ton per 12-ft. panel. This weight would have been increased 3½ tons per panel by filling the pipe with water and 8 tons more per panel by raising the pressure to 130 lb. due to the longer length of pipe on the lower side of the curve. This necessitated fixing the seaward bulkhead inside the pipe at the bottom of the skidway, and in order to relieve the tension on the joints it was decided to fasten this bulkhead to the shore end by two 1⅜-in. plow-steel cables passing through the pipe. In order to compensate for the stretch in the cable as the pressure was increased, a piston 36¼ in. in diameter moving in a cylinder 10 ft. in length was provided on the shore end, as shown in the drawing. Apparatus was also provided for taking up the slack of the cables and putting a moderate initial strain on the cable so that full advantage could be taken of the possible 10 ft. of travel of the piston. Of the total tension of 91 tons about 65 tons was taken up by the cables and the other 26 tons came on the joints.

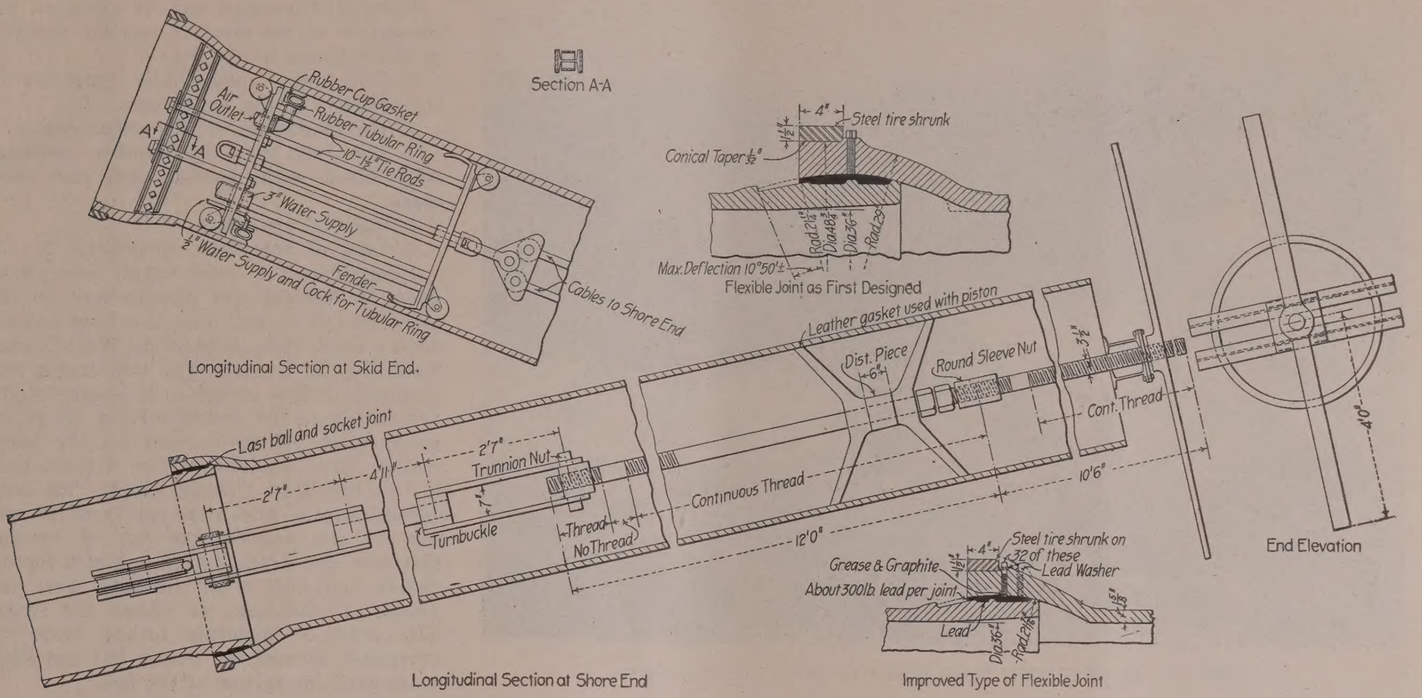
Three Joints Buckle

The pressure was run up to 134 lb. per square inch on Oct. 27 and the line was apparently tight, but because of a breakdown of the pump no measurement could be made. The pressure was relieved, and on the next day it was impossible to get it higher than 105 lb. per square inch, at which point there was a leakage of about 50 gal. per minute. The pipe was immediately filled with air, which rose to the surface in the vicinity of the skidway. Divers reported that three joints just off the skidway had buckled in a horizontal plane. An iron stop on the spigot end (see drawing) prevents rotation beyond 10 deg. 50 min. around the center of the pipe as an axis, but the force had been so great that rotation had continued around the iron-to-iron contact as an axis, thus prying the spigot out of the bell on the first joint about 1½ in. when the pipe jammed. The second and third joints had been pried out about ½ in. each. At the first joint the pipe was about 2 ft. out of line.

The pipe was pulled into line by means of cables fastened by divers and lead to scows moored on either side of the line. Unfortunately one of the cables was fastened to the bell instead of the spigot side of the first joint, and in moving back the bell sheared off 40 lb. of the exposed lead. The repair of this joint in 60 ft. of water with only 1 to 1½ hours' time available at each turn of the tide consumed 10 days, and was accomplished by forcing in 12 lb. of lead through the forward set of jib screw holes, calking on the outside with lead wool and calking on the inside where the lead was exposed in an annular space of ⅜ in. through the 1½-in. movement of the spigot out of the bell.

Three different theories have been advanced for the cause of the failure of the pipe:

(1) That the piston stuck in the cylinder as the pressure was let off and the cable being held in tension brought an



DETAILS OF LINE TESTING APPARATUS AND SECTIONS OF ORIGINAL AND IMPROVED FLEXIBLE JOINT

excessive pull on the pipe as a column.

(2) That the pipe on the skidway, which was filled with water, crowded down and brought an excessive weight on that part of the line under test.

(3) That the pipe near the skidway was slightly out of line when the pressure was applied and that the consequent unequal pressure caused the deflection.

The author is of the opinion that the first of these theories is correct, although the others may have contributed to the damage after the deflection had started.

After the completion of repairs it was decided to resume the hydrostatic test with the following modifications: The pressure was not to be raised above 100 lb. per square inch and the pipe on the skidway outside the seaward bulkhead was to be kept empty. This made the total tension 88 tons, of which 50 tons would be taken by the cable and 38 tons by the joints.

AMOUNT OF LEAKAGE

The test was completed successfully with the following results: Leakage at 100 lb. pressure, 4½ gal. per minute; leakage at 90 lb. pressure, 5½ gal. per minute; leakage at 80 lb. pressure, 6½ gal. per minute. About 1400 ft. of pipe with 118 joints were included in the test. The test was conducted at several pressures with a view to plotting a curve which would give the probable leakage at 130 lb. It will be noted, however, that the leakage decreased as the pressure increased. This is characteristic of flexible joints of this type, and is due to the greater strength of the bell which causes it to expand less than the spigot under pressure, and also in a slight measure to the tendency of the tensional strain to tighten the joints.

The test was considered highly successful, and was followed by an air test at 60 lb. pressure to determine whether letting off the pressure had resulted in any further buckling. While letting off the pressure this time the piston was jarred continually with a heavy rammer to prevent it from sticking. Due to the precautions taken the pipe suffered no damage from the second test, and the test apparatus and cables were immediately removed and pipe laying resumed. It is not intended to make any more hydrostatic tests until the completion of the work, but air tests at 60-lb. pressure will be made at intervals.

The work is being done by the Merritt & Chapman Derrick & Wrecking Company, of which W. L. Chapman is secretary, Ralph E. Chapman, mechanical engineer, and Messrs. Long & Miller, consulting engineers. I. M. Tooker and Charles Everett are the superintendents.

For the Board of Water Supply J. Waldo Smith is chief engineer, W. E. Spear, department engineer, the author, division engineer, and E. H. Hopson, section engineer. The changes in the joint from the original design were made from suggestions by W. L. Chapman and T. H. Wiggin, senior designing engineer, Board of Water Supply. The careful and trying experimental work, lasting over three months, was carried out by Ralph Chapman and M. H. Freeman, assistant engineer of the water board.

New American Tunneling Record at Rogers' Pass

Progress of 817 Feet Was Made Through Slate Material During Month of November on Canadian Pacific Railway's Work

A NEW American hard rock tunneling record of 817 ft. in one month has been made in the Rogers' Pass tunnel of the Canadian Pacific Railway at Glacier, B.C. The following is the November construction progress for the work, which was described in detail in the Engineering Record of Dec. 5, page 604:

East end, center heading, 588 ft., schist, with some quartzite.

East end, pioneer heading, 529 ft., quartzite, with some schist.

West end, center heading, 654 ft., slate, with small quartzite bands.

West end, pioneer heading, 817 ft., slate, with small quartzite bands.

The west end pioneer heading, where the record was made, was driven down grade through rock that could not be broken over 6 ft. per round. The greatest footage for one day was 37 ft.

Joseph Murphy is assistant superintendent at the east end and Joseph Fowler is assistant superintendent at the west end. The information in this note was supplied by A. C. Dennis, superintendent for the contractors, Foley Bros. Welch & Stewart, Glacier, B.C.

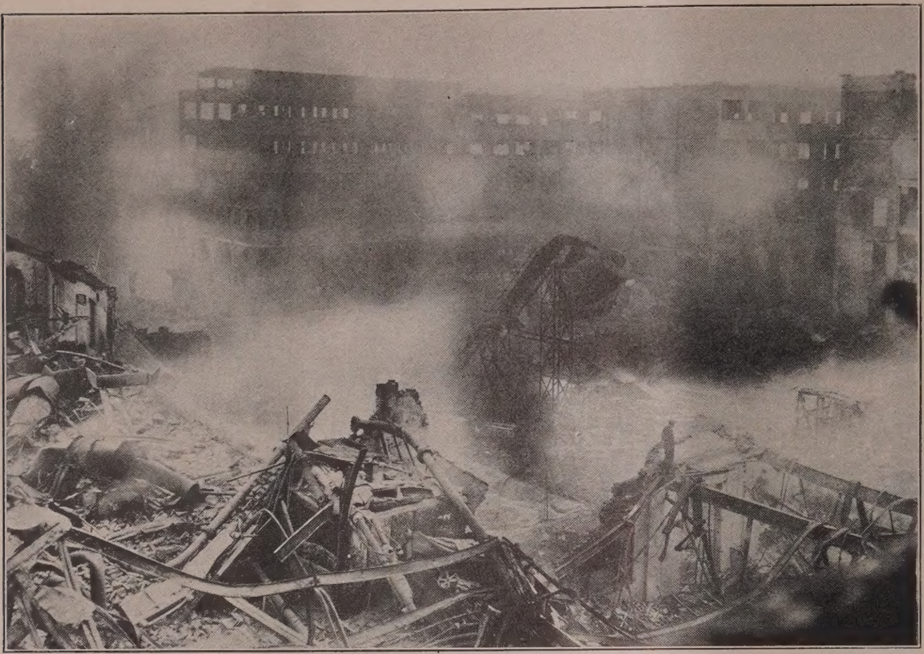
The previous American record was 810 ft. in 31 working days made in the Mount Royal tunnel of the Canadian Northern Railway at Montreal.

Preventing Odors at Refuse Disposal Plants

HIGH furnace temperatures, forced draft and careful regulation of the fires to secure perfect combustion are necessary to prevent odors at refuse disposal plants. These are among the points made by Dr. Rudolph Hering, consulting engineer, of New York, in a paper presented at the recent meeting in Jacksonville of the American Public Health Association.

To prevent odors about the plant, Dr. Hering said, no refuse should be stored longer than a day before it is incinerated, although an offense from mixed refuse does not arise as soon as from garbage alone as generally delivered at a reduction plant. It is further generally wise to arrange hoods and ventilating pipes in the furnace building to receive and carry the air, which may have become somewhat foul from contact with the refuse. The foul air should be conducted to a point below the furnace grates and used with forced draft, so that the intense heat of the fire will thoroughly purify it.

As at reduction works it is advisable to keep incinerating works scrupulously clean. No refuse should be left scattered about. Dust from the final clinker and ashes should be properly controlled, and the floors of the buildings should be swept or washed daily. The walls of the buildings, the tools, clothing, etc., should be given, as often as found desirable, a blast from nozzles supplied with compressed air.



VIEW TO THE SOUTHEAST FROM BUILDING 24, EDISON FACTORY

Disastrous Fire at Edison Factory

Concrete Buildings in General Suffer but Little, Though There Is Severe Local Damage Due Probably to Intense Heat and Water

Accompanied by Folding Inset Plate

On account of Mr. Edison's prominence, unusual attention has been given to the fire which destroyed a large part of the plant of Thos. A. Edison, Inc., at West Orange, N. J., during the evening of Dec. 9. The reports included, generally, a statement that the concrete buildings, supposedly fireproof, had been destroyed, thus—so it was intimated—failing to justify the reliance placed upon them. So strong were the statements that the Engineering Record has received from various parts of the country letters of inquiry from those whose knowledge did not allow them to accept the newspaper accounts at their face value. It may be stated at the outset that the accounts need decided qualification. While it is true that the inflammable contents were consumed wherever the fire reached, and the machinery damaged, the seven concrete buildings attacked still stand, while about them are the tangled and hopeless ruins of one frame and six brick buildings. The count of brick buildings may be open to dispute, since they were largely built continuously and some of them here counted separately, and so considered by the management, were physically not independent structures.

THE FIRE

The fire started about 5:30 p. m. in the film inspection building, a one-story, sheet-iron structure, located about the center of the plant, as indicated in the accompanying drawing. The plan does not show the entire plant. North of Alden Street are five other buildings, three of them small, while south of Lakeside Avenue is the storage-battery plant, controlled by an allied company, the Edison Storage Battery Co. None of these structures was damaged, the fire being confined to the plot shown. It will be noted that the buildings are very close together.

On account of the highly inflammable character of the contents of the building in which the fire started, the progress of the fire was unusually rapid, and so intense that the adjoining buildings, the box and cabinet factory (a three-story frame building) on the west and the phonograph assembly department (in a concrete building) on the east, were soon in flames. These structures also contained much inflammable material in the way of wooden phonograph cases and packing boxes. The first, or ground floor, of the assembly building was used by the shipping department and was well filled with finished machines in packing cases.

With this start, the fire rapidly continued its spread both eastward and westward, such being its rate of progress that it had virtually spent its force by midnight and was under control. Five small buildings at the east and the group of small buildings at the west, these including the famous laboratory in which Mr. Edison's investigative work is planned and largely done, were saved.

Five chief reasons can be assigned for the extent of the disaster and the rapidity of the progress of the fire:

1. The highly inflammable character of the contents of the buildings.
2. The inadequacy of the water supply.
3. The fact that the window openings were fitted with wooden sash and plain glass.
4. Lack of fire walls.
5. Lack of automatic sprinklers.

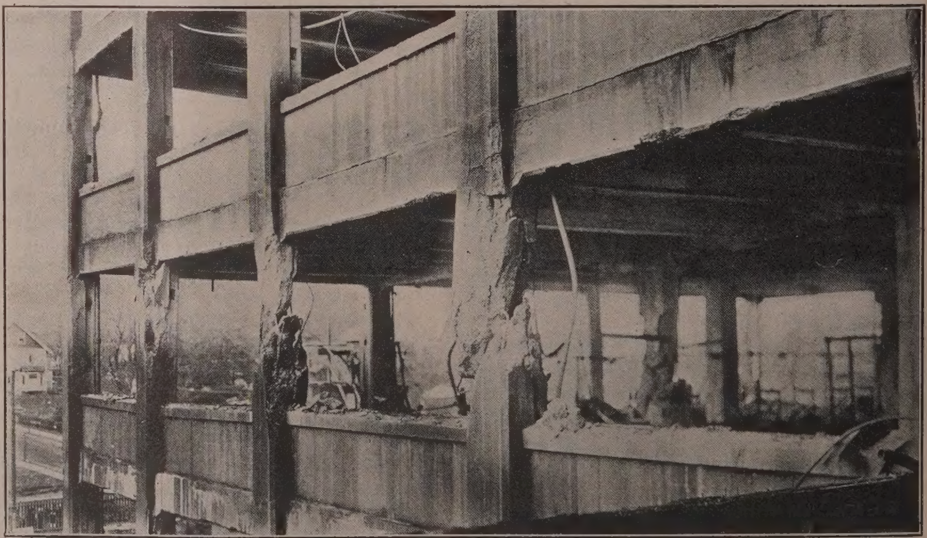
Dependence for water supply was placed upon an 800-gal. per minute well on the premises and several 6-in. pipe lines leading from a single 8-in. main of the West Orange water supply system. The well supply was rendered useless in the early stages of the fire, owing to the forced cutting off at the power house of the current for the pump motor. Sole dependence, for a time, then lay on the West Orange supply, but later several lines of hose were run from the system of the neighboring city of Orange However, the streams were no match for the flames and only with difficulty were the groups of buildings at either end saved. The wind, a moderate breeze from the northeast, fanned the flames but had little to do with the spread of the fire.

Comment on the lack of proper fire-prevention measures will be found in the editorial pages of this issue.

EFFECT OF FIRE

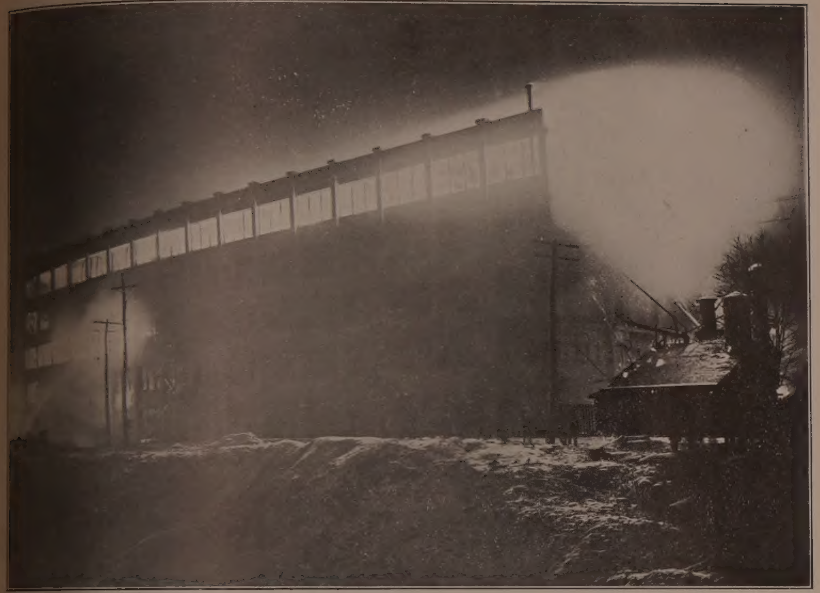
In considering the effects of the fire, the buildings naturally divide themselves into two groups, those built of concrete, and those of other types of construction. These other types of construction included one frame building, one sheet-iron structure, one brick building with steel frame and a number of brick structures with ordinary timber framing.

As to the last group—buildings other than concrete—one generalization will cover their present condition; they are total ruins. Except for what salvage there may be in brick and tangled iron the structures themselves are total losses. While the Edison authorities have made no statement as to the salvage of contents it is likely that the recovery of material in this group of buildings will be comparatively small. In fact, much of it was of an exceedingly inflammable character, which would not have been saved in any type of building. In the punch department, at the east end, housed in a one-story brick building with timber



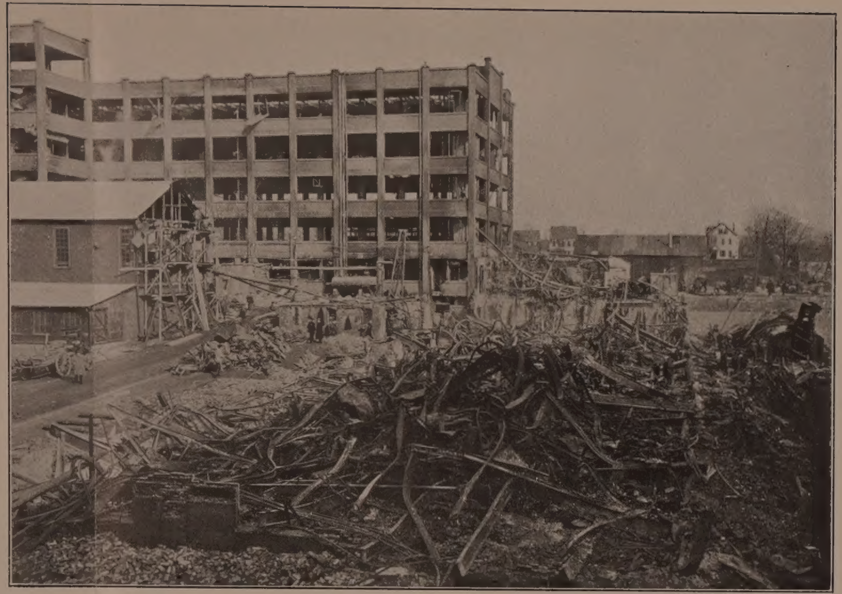
COLUMNS ON SOUTH WALL LINE, WEST WING OF BUILDING 24

Supplement to Engineering Record of Dec. 19, 1914,
accompanying article on Disastrous Fire at Edison Factory, page 660



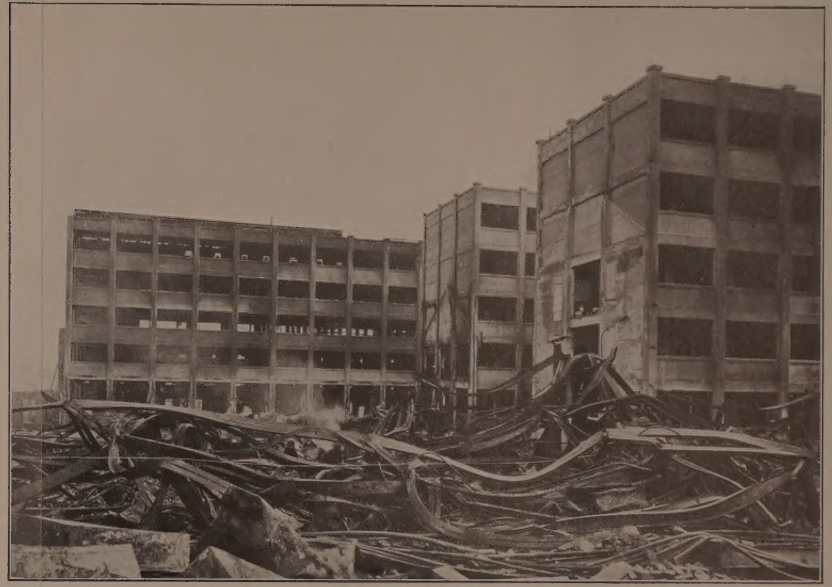
Building 24 from the Northwest During Fire.

Fire in top floor almost burned out before blaze was well under way in lower floors. Note feeble stream being played at left.



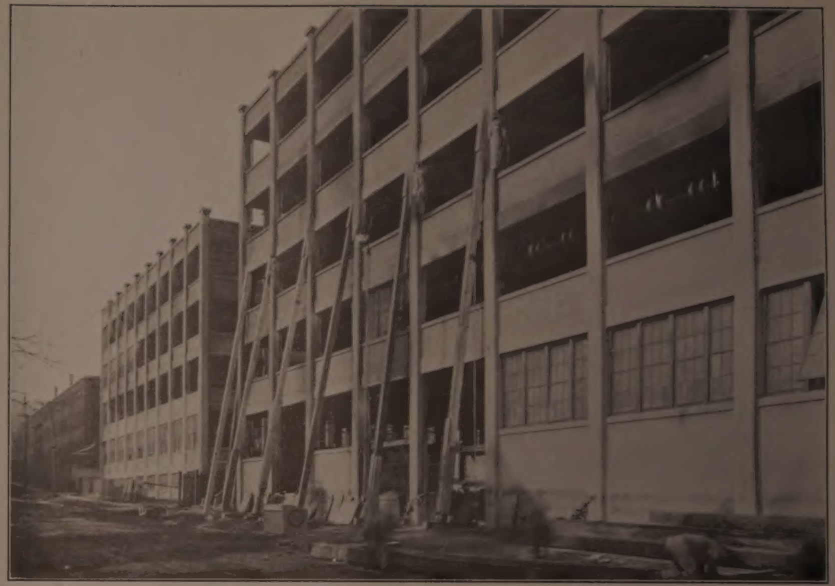
Looking Northward, with East End of Building 24 in Distance.

In foreground tangled wreckage of Building 21, a two-story brick building with steel frame.



Looking Eastward, with Building 11 in Distance.

Wreckage of Buildings 21 and 18, and Film Inspection Building in foreground. Note where last two buildings joined concrete structures.



South Side of Building 15; Concrete Office Building on Left.

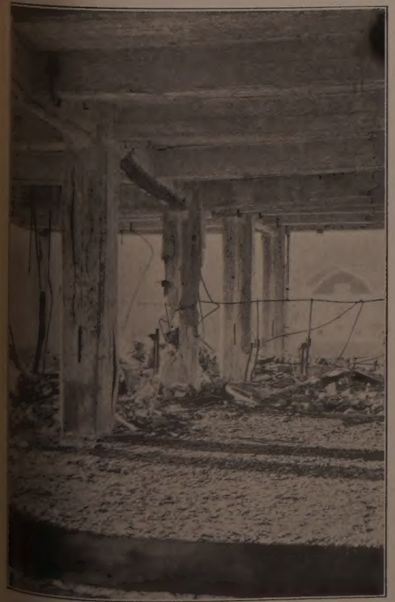
Shoring at five wall columns which were badly damaged. Note excellent condition of remainder of structure and that windows are still in place in first floor.

PHOTOGRAPHIC RECORD OF THE EFFECTS OF THE FIRE AT THE EDISON FACTORY IN WEST ORANGE, N. J., DECEMBER 9, 1914

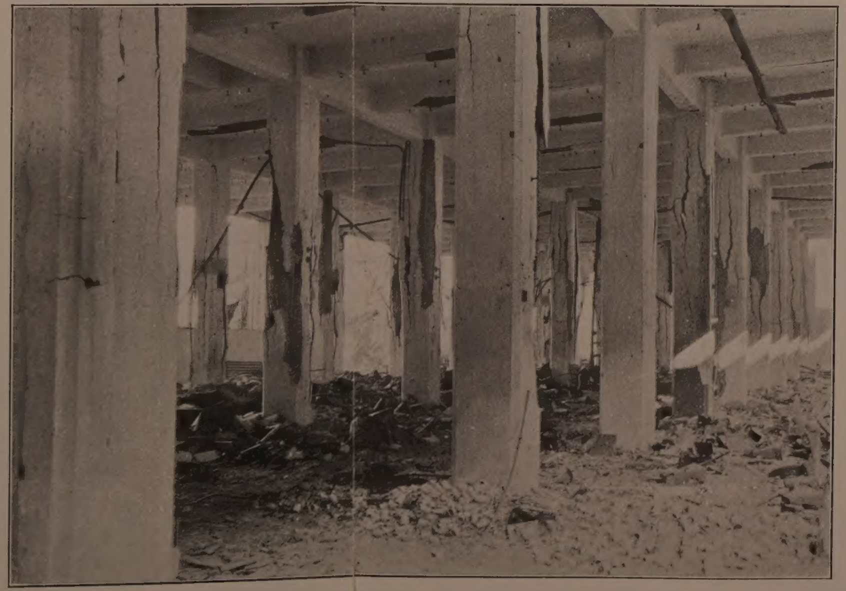
The concrete suffered more severely in the first floor of Building 11 than in any other part of the plant. The heat here was intense, due to a large stock of crated phonographs and phonograph records awaiting shipment. It is known that streams of water were played in this room during the height of the fire. The concrete here is almost a pure white, contrasting with the discoloration and blackening elsewhere. It has been suggested that the heat was sufficiently intense to consume the soot ordinarily deposited. The building is standing, though three-fourths of the columns are seriously reduced in effective cross-section. The concrete in the upper floors is in good condition. The restoration of the building, a procedure to be expected, offers a most interesting construction problem.

Failed Column, Third Floor, Building 24.

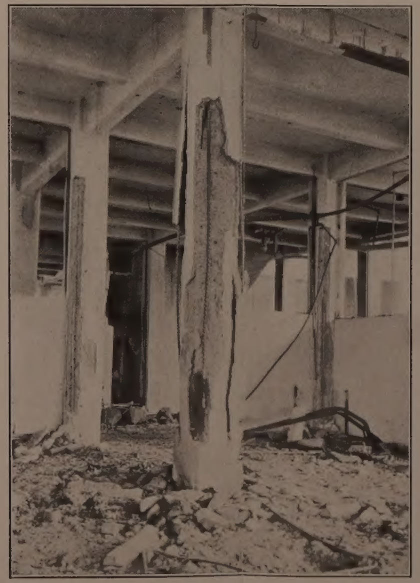
Five columns in south wall and three in north, on either side of column shown were also destroyed



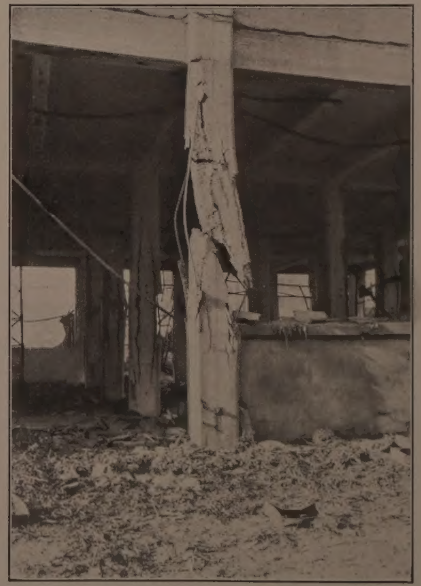
Condition of Columns, First Floor, Building 11.



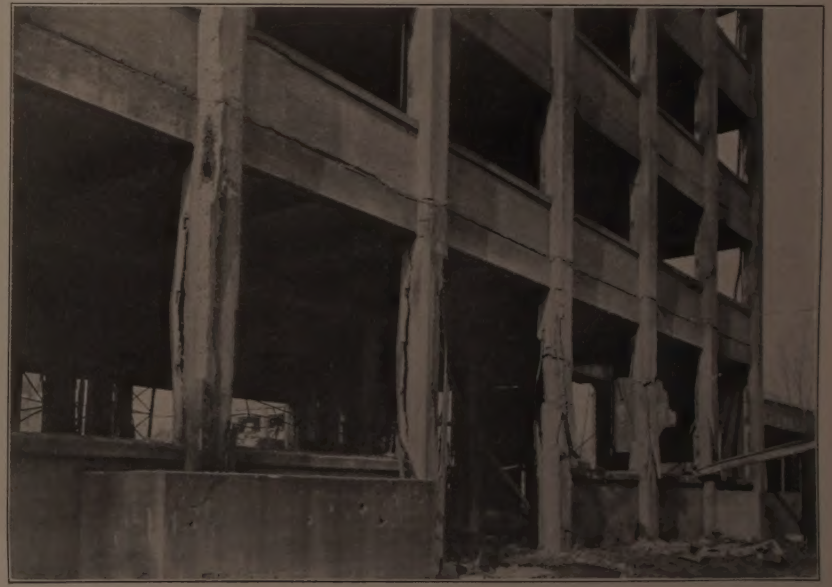
Column, First Floor, Building 11.

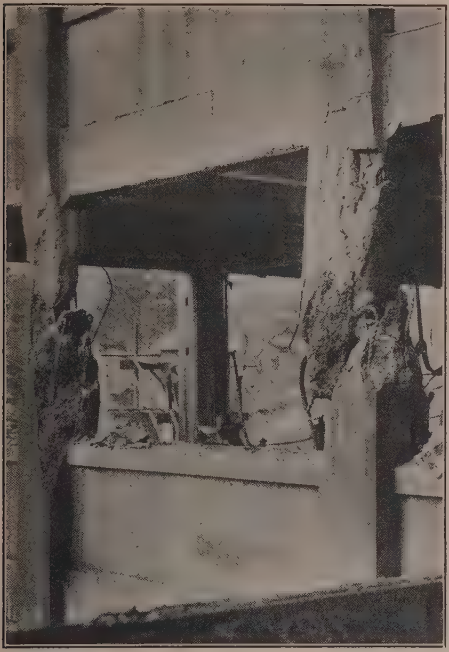


Wall Column, First Floor, Building 11.



Columns along East Wall, First Floor, Building 11.





TYPICAL COLUMN FAILURES, BUILDING 24

framing there will be, apparently, a considerable salvage of machinery.

Only one of the buildings of this group had a steel frame. That was the two-story stock room for records, Building 21, but it should be noted that the steelwork was not fireproofed.

CONDITION OF CONCRETE BUILDINGS

Chief interest in the fire for the structural engineer centers on the condition of the concrete structures. Reference to the plan drawing herewith shows those which were attacked by fire. It will be noted that the buildings facing Lakeside Avenue while marked to indicate a number of adjoining structures, are really one long building with wings extending northward into the interior of the plant area. A study of the drawing shows how easily the fire was able to extend to them. The box and cabinet factory and the film inspection department abutted buildings 13 and 15, so that the fire was immediately communicated to them. Building 25, the office, was detached.

With the exception of certain sections in buildings 24, 15 and 11 and the entire wing of 11, the concrete buildings appear to be in good condition. Without exception they are standing and the salvage in contents, damaged but not wholly destroyed, will be very large. This is an important factor in considering the performance of these structures in fire. Moreover, in certain structures completely gutted in the upper stories, but little damage was done in the first floors. This is true of the office and of buildings 13, 15 and 24, and is in marked contrast with the brick structures, where the collapse of the buildings resulted in a very high contents loss.

In floors occupied by machinery working on metal parts, the concrete was not seriously injured. Columns spalled here and there, without, however, exposing the reinforcing rods, and occasionally, but not often, the beams also spalled. In general, the more destructive effect of the fire upon the columns than on the beams is noticeable.

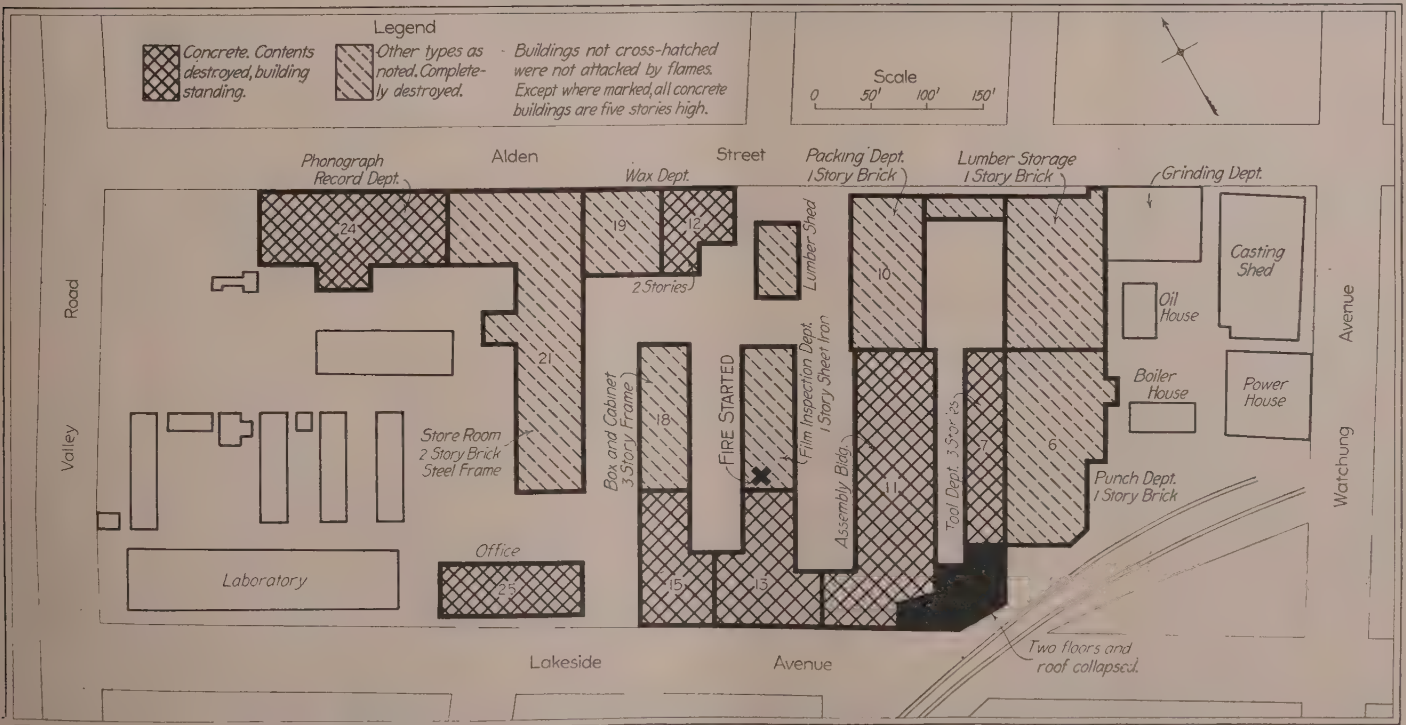
The workmanship appears to have been of the best. Trap rock was used as the aggregate in most of the buildings; gravel in the others. There is no apparent difference in their fire resistance. The effect of the fire on the columns extended generally to a depth of about 1½ in., this being the usual depth of spalling. Except where the fire was very severe the concrete did not come off and the rods were not exposed. However, longitudinal cracks are found on many of the columns. Where the fire was hot cracks close together are found across the bottoms of beams. This is particularly noticeable in building 24, where also the cracks between floor-beams and the under side of floorslabs are conspicuous. The cracks just mentioned are rather to be expected since the beams and slabs were not cast monolithically.

The column reinforcing consisted only of four vertical rods, without horizontal ties or hooping. The steel was thus inadequate to prevent the typical shearing failure shown in illustrations herewith.

Building 11, the assembly department, seems to have suffered most. While the four upper floors are in good condition the ground floor of the wing, used by the shipping department, is in very bad condition. The room was piled high with phonographs in wooden packing boxes, making a very hot fire. Many of the wall columns are broken so badly that settlement has taken place, while of those in the interior fully three-fourths seem to be very seriously damaged. This statement is made only after such examination as was possible from the outside of the building, permission to enter being refused because of the possible danger of collapse. In many cases the rods have broken out and the section of the column very seriously diminished. Where the rods have not broken out large triangles of concrete at each of the four corners are slivered off almost the entire height of the columns. There seems to be but little doubt that if this structure is saved it will be only by replacing entirely the columns in the lowest story.

Building 11 also suffered severely at the south end, in the section marked in black on the accompanying plan. This shows the area over which two stories and the roof of the structure collapsed. Before the fire it was known that this section was overloaded and work was under way at the time the disaster occurred in removing some of the excess weight. While there is no special evidence of exceedingly hot fire in this location, another factor—the playing of fire streams on the hot concrete—may have entered.

Next to building 11, the most serious damage was done in the west wing of No. 24, and here the damage was due to an exceedingly hot fire on the third floor. Twenty tons of wax was stored there and the result is shown by the destruction of four columns on the south wall line, three columns on the north wall line and one in the interior. That this wing did not collapse entirely is a marvel. There is a deflection at the interior column of at least 15 in.,

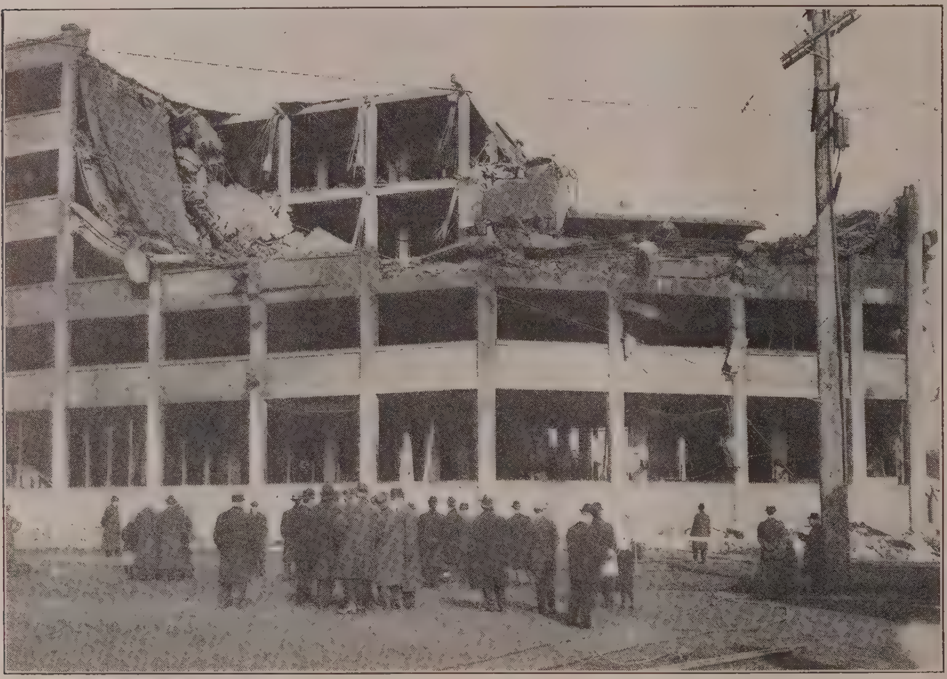

Legend
Concrete. Contents destroyed, building standing.
Other types as noted. Completely destroyed.
Buildings not cross-hatched were not attacked by flames. Except where marked, all concrete buildings are five stories high.
Scale
0 50' 100' 150'
Phonograph Record Dept.
Alden Street
Wax Dept.
Packing Dept. 1 Story Brick
Lumber Storage 1 Story Brick
Grinding Dept.
24
19
12
2 Stories
Lumber Shed
10
Casting Shed
Oil House
Road
Valley
21
Store Room 2 Story Brick Steel Frame
Box and Cabinet 3 Story Frame
18
FIRE STARTED
Film Inspection Dept. 1 Story Sheet Iron
Assembly Bldg.
11
Tool Dept. 3 Stories
6
Boiler House
Power House
Punch Dept. 1 Story Brick
Avenue
Watchung
Office
25
Laboratory
15
13
Two floors and roof collapsed.
Lakeside Avenue

PLAN OF EDISON FACTORY, SHOWING LOCATION AND TYPE OF BUILDINGS ATTACKED BY FIRE and the beams and girders running out therefrom are badly cracked, so much so that they probably have little remaining strength. Below this floor, the west wing, as with the rest of the structure, is in good condition. On the whole the fire in this building seems to have been very hot. There was considerable wood used in boxes holding finished and partly finished products, while in many parts were wax and also celluloid for cylindrical phonograph records.

In one other place the local damage was severe. Four columns on the wall line of building 15, on the Lakeside Avenue front, were destroyed. The rest of the structure, however, is in good condition and it is likely that this local damage can be remedied by permanent shoring.

Effect of Water

Company officials state that wherever serious damage was done fire streams were directed on the concrete after it had become heated. This statement is based on the testimony of competent employees, and applies to the severe local damage in buildings 11, 15 and 24. It is the belief of the officials that despite the great heat at certain points there would have been very little damage had the streams not been used on the concrete structures, or at least not directed at them after they had become very hot.



COLLAPSED SECTION, SOUTHEAST CORNER BUILDING 11, EDISON FACTORY

Plaster blocks were used extensively around stairways and did not withstand the conflagration.

In order to ascertain the extent of the damage and what buildings and parts of buildings are usable, the plant managers have had a detailed survey. No word as to the findings has yet been given out, except that the three specialists employed have reported that 87½ per cent of the concrete construction is in first-class condition.

THE SOUTHERN NATIONAL HIGHWAY, between San Antonio and El Paso, Texas, is being pushed as rapidly as possible. Those in charge are to complete the work in time for travel to the Panama-Pacific Exposition.

New York Transit Contracts

More than 19,000 Men Employed on Contracts Involving $146,253,346—City Paying $2,000,000 a Month—Nineteen Contracts Unlet

REPORTS showing progress on the new subway contracts of the dual system in New York made by the division engineers to Alfred Craven, chief engineer of the Public Service Commission of the First District, show that there are now 19,223 men employed by the several contractors for the city and the two companies, the Interborough Rapid Transit Company and the New York Municipal Railway Corporation. The construction work to be done by the city is divided into eighty-three contract sections. Contracts have been awarded for sixty-four of these sections, leaving only nineteen to be awarded. The total contract prices of the sixty-four sections on city-owned lines already let is $146,253,346, of which $76,172,289 is on Interborough lines and $70,081,056 on New York Municipal lines. In addition, the Interborough Rapid Transit Company has under way the third-tracking of the Manhattan and Bronx elevated lines, which, it is estimated, will cost from $8,000,000 to $10,000,000; and the New York Municipal Railway Corporation has under way elevated third-tracking and extension contracts involving about $6,000,000, so that the grand total of work now going on in different parts of the dual system involves an expenditure of about $162,000,000. The average disbursements are now about $2,000,000 a month, and for the next year it is estimated payments will run from $2,500,000 to $3,000,000 a month.

Interborough Lines

As regards the lines for operation by the Interborough Rapid Transit Company, it is expected that the two contracts for the Lexington Avenue line will be completed during 1917; that both contracts on the Jerome Avenue line will be finished during 1915; that on the White Plains Road line, an extension of the existing subway from its terminus at 180th Street north to 241st Street, work will be finished during 1915; that the Southern Boulevard extension of the Lexington Avenue subway to Pelham Bay Park will be completed in 1916; that the Seventh Avenue line, entirely under contract, will be completed early in 1917; that the Park Place, William and Clark Street line will be completed about the end of 1917; that the Eastern Parkway line, an extension of the existing subway from Flatbush Avenue, in Brooklyn, through Flatbush Avenue and Eastern Parkway to Buffalo Avenue, will be completed during 191”; that the Queens lines, one running north from the Queensboro Bridge through Second Avenue to Ditmars Avenue, Astoria, and the other northeasterly to Alburtis Avenue, Corona, both of which are under contract and well advanced toward completion, will be completed in advance of the contract dates.

Steinway Tunnel

The Steinway tunnel, built by the Interborough interests and purchased by the city, a portion of which is being reconstructed for temporary operation in connection with the existing subway, is now about 60 per cent completed. The contract for the Steinway tunnel extension, running from the Queens end of the Steinway tunnel in Long Island City to a junction with the Queens lines at the Queensboro Bridge Plaza, is about 28 per cent completed. As regards the Steinway tunnel extension in Manhattan under Forty-second Street to Times Square, surveys and maps are made and work on the plans is in progress. All the preceding lines are to be owned by the city of New York.

Brooklyn Rapid Transit

As regards the New York Municipal lines it is expected that the whole work on the Broadway line in Manhattan will be completed during 1917. The Whitehall-Montague Street line under the East River is entirely under contract, but the contracts have only recently been awarded. It is now about 2 per cent completed. The time for the completion of the tunnel will expire at the end of 1917. The two-track subway under Canal Street connecting the Broadway line with the Fourth Avenue subway in Brooklyn is about 4 per cent completed. The Fourth Avenue subway, Brooklyn, is practically completed from the Manhattan Bridge to Forty-third Street. The extension from Forty-third Street to Eighty-sixth Street has been under contract since October, 1912. The section north of Sixty-first Street is 72 per cent and the section south of Sixty-first Street 60 per cent completed. It is expected that the whole line will be completed next year. The contractor for the installation of tracks has begun work from both ends of the completed portion of the subway.

THE FORT MASON TUNNEL at San Francisco, which gives direct rail connection with the exposition grounds, has been completed and accepted by the State Board of Harbor Commissioners. The tunnel, which passes underneath Fort Mason, is 1500 ft. long and cost $216,000. The tracks of the Municipal Belt Railway are being laid through it and connected with the 11 mi. of track on the grounds, which run into all the exposition palaces, so that freight shipments from the East to the exposition are delivered in any of the palaces without rehandling.

American Road Builders' Association

Abstracts of Papers Presented by William D. Uhler, J. A. Johnston, Clifford Older and H. J. Kuelling at the Eleventh Annual Convention Held at Chicago, December 14-18

Bituminous Construction and Maintenance—Recent Practice

By WILLIAM D. UHLER
Principal Assistant Engineer, Bureau of Highways and Street Cleaning, Philadelphia

IN building bituminous macadam by the penetration method, after the base has been prepared, and clean, approved hard stone has been spread to the required depth, the recognized practice is to use from 1¼ to 1½ gal, per square yard of bituminous material conforming to the specifications. Then after chipping and rolling, a flush or seal coat is applied of from ¼ to ½ gal. per square yard and another application of chips, before the final rolling.

The tendency has been to discontinue this method of construction where it is practical to use the mixing method. Although it is an admitted fact that the penetration method is slightly cheaper in first cost than bituminous concrete, when the life and maintenance of the respective pavements are taken into consideration it is doubtful whether the penetration method is not more costly than the mixing method.

Mixing Preferable to Penetration

There probably has been more deterioration in roads built by the penetration method than in any other modern type of construction. Even if the method of construction were more ideal it is questionable whether the penetration method should be used, as at the present time there are on the market a number of portable mixing plants of all sizes that would be practicable in most sections of the country, and it is generally conceded that the mixing method is preferable to the penetration, provided first cost is not the dominating factor.

The specifications in Philadelphia are as definite and rigid in their stipulations covering the preparation and laying of bituminous concrete pavements as they are in the case of sheet asphalt. All these pavements are now being laid on a 4-in. concrete base instead of on an existing macadam foundation, which heretofore has been the generally accepted practice on country roads. In conjunction with the concrete base a concrete header curb is constructed extending 6 in. beyond the fixed edges of the bituminous pavement and to the finished grade. After the concrete base has developed a hard set, and from one to two days prior to the placing of the bituminous wearing surface, the base is thoroughly cleaned of loose and foreign material, by sweeping, and is then covered with an asphaltic cutback mixture consisting of equal parts by volume of asphaltic cement (55 to 65 penetration) and commercial naphtha (52 to 55 gravity), the mixture being applied by a pressure distributor at the rate of ⅛ gal. per square yard. The object of this paint coat is to secure a better bond between the concrete base and the bituminous top. The bituminous top, 2 in. in thickness, is laid under the same requirement as to preparation, laying, rolling and inspection as for sheet asphalt. Where a new pavement is laid on the earth sub-grade a 5-inch concrete foundation is used.

Concrete Header Curb

Recent experience has demonstrated that this method of construction might answer for wide roads with light traffic, but where the width of the paved surface is 18 ft. or less, the turning of traffic on and off the bituminous surface will result in grinding or cracking the edges and also, unless a perfect bond has been secured with the base—and this cannot be relied upon — heavy wheel loads, at a distance of 1 to 2 ft. from the edge, will produce a spreading of the bituminous surface. To obviate this, provision is made in the Philadelphia country road specifications for a 6-in. concrete header curb on either side of the road where the road is not paved to the full width.

Road Foundations

By J. A. JOHNSTON
Division Engineer, Massachusetts Highway Commission

SURFACING is secondary to foundations. The statement has many times been made that a waterproof surface requires little or no foundation because no water can get through it to the soil beneath. Many horrible examples might be cited to show the fallacy of this belief. A little consideration of the capillary action of the soil which draws water from the sides of the road and underground sources, as well as the water that will seep through the soil from higher points, will show that a waterproof surface is not sufficient unto itself without a proper base.

Gravel Foundation

The right kind of gravel, makes an excellent foundation, but most gravel contains enough silt, loam or clay to so draw moisture by capillary attraction that the frost will work in it and, of course, when the frost crystals thaw, it leaves the material porous, spongy and wet. This condition is aggravated by the rolling wheels passing over the surface and the tamping action of horses' hoofs, which all tend to puddle it just as a tamper puddles concrete, drawing the moisture from below. Such a result, unless extreme, may not be serious if your road surface is of gravel or even water bound macadam, for such surfaces are easily and cheaply repaired, but if the road surface is a high cost bituminous mixture it may be ruined. Gravel alone cannot safely be trusted for foundation, and should never be used under a high cost surfacing except as a sub-base under stone foundation or concrete.

Drains

In our earlier work we depended largely on side drains 3½ ft. deep at the edges of the macadam. A 5-in. pipe was placed in the lower part of the trench and the drain filled with small stone fragments. Our theory was that these drains would dry out the subgrade and keep the road surface firm. We built miles of these drains, but they did not accomplish the desired results unless they were supplemented by a stone base under the macadam; and subsequent experience has shown that, except in rare cases, if the road is built over a proper stone foundation, the side drain is unnecessary.

One of John McAdam's theories was that no stone larger than you could hold in your mouth should be used in a road. We have proved that crushed stone of small size is not satisfactory for foundation and is suitable only for surfacing. My theory of this is that the units are so small they have little bearing, and as they have no cohesion when wet sink readily into the mud. Regardless of theory, the fact remains that that is the effect, and some of these stone particles have been found a foot or more below the original subgrade. It should also be borne in mind that the cost of the crushed stone is nearly three times as great as that of the larger size fragments.

Stone Foundation

Because of inherent defects in the V-drain we have for several years been building stone foundation with a flat subgrade. If the bottom is a soft clay or silty material which would work up into the voids of the stone foundation we first place over it a bed of sandy gravel, when such material can be obtained, varying in thickness as the conditions may require—in some places 6 in., in others 12 in.—and over this stone fragments not exceeding 8 in. in their largest diameter are placed. The depth of this stone foundation is never less than 8 in. in the center and 4 in. on the edges, and under extreme conditions we have used 18 in. in the center and 14 in. on the edges. No attempt is made to place these stones as a paving, though some care is taken to lay the bottom stones on their broadest face to ensure a substantial bearing. I am aware, this is contrary to the theory that a stone laid flat will tilt and cause trouble, and that the usual practice is to place telford stone on edge, but we have built many miles in this manner without trouble. Small stones are thrown on top to close the surface crevices, the whole is then rolled with a steam roller until hard and firm. This thorough rolling we believe to be one reason for freedom from trouble from tilting stone.

If a bituminized surface is to be placed on the road the voids of the sub-base are filled with clean, sharp sand (and we insist that this material shall be clean), this is rolled without wetting and any surplus that remains on top of the base is swept off. This sand filling, however, is not an essential part of the base, but is used only to prevent the loss of bitumen. Bleeders are used, to drain the water from this foundation, at proper outlets, and care is taken to so build these outlets as to avoid future clogging.

Foundations of this description have a fairly uniform frost action, appear to be preferable to the V-drain and have been satisfactory. The costs, of course, vary with the conditions, running from about 15 to 60 cents per square yard.

CONCRETE BASE

If a surface of wood, stone or brick blocks, or the more expensive types of asphalt is to be used, a concrete base is accepted as the best practice. Cracked pavements over concrete bases can be largely guarded against by proper drainage. There is some difference of opinion as to whether it is better to build a fairly light base of strong concrete (4 in. of 1:2:4 mixture) or a heavier base (8 in. or more of a leaner mix, 1:3:6, 1:4:8). Conditions should decide this. In a mixed soil better results might be obtained by the greater depth of the lean mixture, as there would be less frost action at the greater depth, and the increased depth of the concrete slab should more than offset the loss in tensile strength of the material. If it is planned to build a concrete road surface with the ultimate idea of surfacing it at some later time with bitumen or other material, there is no room for argument as to the use of a rich mixture, for it is then necessary to so mix your concrete that it will withstand the abrasion of the traffic. If the bituminous surface is to be only a light one it is still advisable to use the rich mixture, as the shock of the passing traffic may cause enough surface disintegration to destroy the bond of the bitumen to the concrete.

Floors for Steel Highway Bridges in Illinois

By CLIFFORD OLDER
Bridge Engineer, Illinois Highway Department

JUDGING from conditions in Illinois, it is probable that at least 90 per cent of all existing highway bridges are provided with nothing better than plank floors, and that the maintenance of these floors costs approximattely 15 per cent of the total expenditure for road and bridge maintenance, or about $10 per mile of road per annum. It seems desirable to select a type of bridge floor which will permit the use of a wearing surface of the same kind as that on the adjacent highway, so that the same method of maintenance may be used on the bridge floor elsewhere.

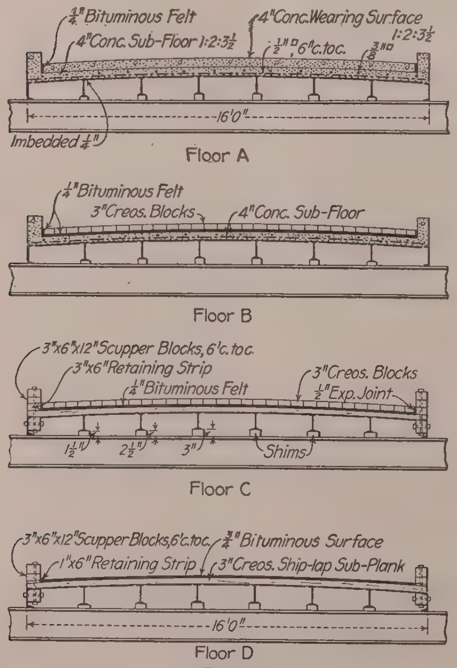
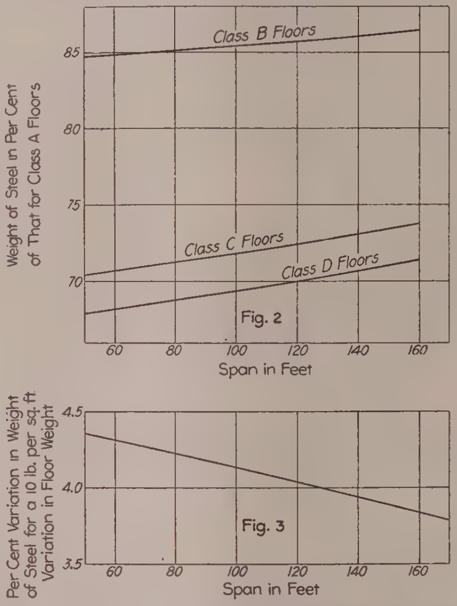


Fig. 1

FIG. 1—STANDARD BRIDGE FLOORS

The difference in weight of various types of floors has but little effect on the design and cost of concrete bridges. Steel bridges, however, are materially affected in both design and cost by a comparatively small variation in the weight of the floor. The saving in the weight and cost of the steel in the trusses and floor system for the lighter floors may out-weigh the advantage of having the same wearing surface on the bridge as elsewhere on the highway. Floors for steel bridges only will be considered in this discussion.

The bridge floor should consist of two elements, the sub-floor, which should be as permanent as the bridge superstructure and should provide the necessary strength to transmit the highway loads to the floor supports, and a wearing surface of such character as to permit of economical maintenance. In considering construction materials for both these elements, the matter of weight increases in importance with the length of span. For sub-floors of the more permanent type buckle-plates with concrete covering, re-inforced concrete, and creosoted plank cover the field. For wearing surfaces, brick, concrete, creosoted block, macadam, gravel, mixtures of bituminous materials with sand, gravel or stone, plank, ordinary soil and practically all other varieties of surfacing materials have been used.



FIGS. 2 AND 3—STEEL FOR SUPERSTRUCTURE

WEIGHT OF FLOORS

For the purpose of considering the effect of the weight of the floor on the design of the superstructure the various types of floors are herein grouped in four classes.

Class A.—Floors which weigh approximately 100 lb. per square foot of roadway surface are included in class A. Floors consisting of a reinforced concrete sub-floor, assumed to weigh 50 lb. per square foot, on which is placed a wearing surface of concrete, brick, macadam or gravel, are of this class. The wearing surface is assumed also to weigh 50 lb. per square foot of roadway surface.

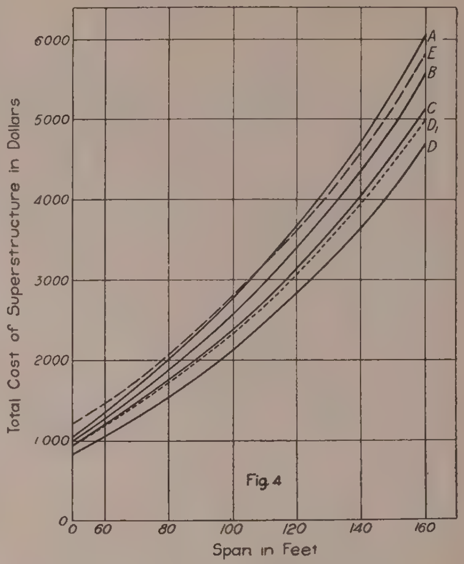


FIG. 4—AVERAGE CONTRACT PRICES

A, sub-floor concrete, surface concrete; B, sub-floor concrete, surface blocks; C, sub-floor plank, surface blocks; D, sub-floor plank, surface bituminous; D_1, sub-floor plank, surface bituminous—includes capitalized maintenance; E, untreated plank floor—includes capitalized maintenance.

Class B.—Floors which weigh approximately 65 lb. per square foot of roadway surface are included in class B. Floors consisting of concrete sub-floor with a creosoted block wearing surface and floors consisting of creosoted plank sub-floors with a brick wearing surface are of this class.

Class C.—Floors which weigh approximately 26 lb. per square foot are included in Class C. Floors consisting of a creosoted plank sub-floor with a creosoted block wearing surface are included in this class.

Class D.—Floors which weigh approximately 26 lb. per square foot are included in class D. Floors consisting of a creosoted plank sub-floor with a wearing surface about ¾ inch thick, composed of a mixture of gravel and bituminous material, are of this class.

Buckle plate floors are not considered, as they weigh as much and cost more than concrete sub-floors.

The accompanying drawing, Fig. 1, shows standard designs used by the Illinois Highway Department for the floors above mentioned. The creosoted plank sub-floors (floor C and floor D), are crowned by bending the plank over the stringers and anchoring the ends to the nailers by means of lag screws. The creosoted blocks (floor B and floor C) are laid on a ¼-inch bituminous felt cushion, which is coated with asphalt immediately before laying the blocks. Ship-lap sub-plank are used for floors having a bituminous gravel wearing surface. The use of this form of sub-plank has been found to be the cheapest and most effective method of preventing the leakage of the bituminous material.

EXPLANATION OF CURVES

The curves in Fig. 2 show the weight of the structural steel in bridge superstructures as a per cent of the weight of the steel in superstructures having class A floors. That is, the weight of superstructure steel in bridges having floors weighing 100 lb. per square foot is taken as 100 per cent, and the weight of steel required for the lighter floors is expressed as a percentage of this weight.

These curves are based on the weight of steel in spans which conform to the standard designs of the Illinois Highway Department. The designs used provide for 16-ft. roadways. The curves were checked at a number of points, however, for 18-ft. roadway designs and were found to conform very closely. These curves are sufficiently accurate to enable a designer to determine the relative cost of steel superstructures having floors of various types and weights.

The curve (Fig. 3) is based on the curves (Fig. 2) and shows the average percent variation in weight of steel for a variation of 10 lb. per square foot in the weight of the floor.

Fig. 4 shows the average contract price for the Illinois Highway Department standard 16-ft. roadway steel spans with floor complete.

For spans up to 80 ft. riveted pony trusses are used. For spans from 90 to 160 ft. riveted Pratt trusses are used. This range of span length covers at least 90 per cent of the highway bridges in Illinois.

The average contract price of materials is as follows:

CONTRACT PRICE OF MATERIALS

Structural steel complete in place	$0.03½ per lb.
Conc. sub-floors, including reinforcement	$12.00 per cu. yd.
Conc. wearing surface, 4 in. thick	$0,90 per sq. yd.
Creosoted sub-plank (12 lb. treatment) complete in place	$70.00 per thousand ft. b. m.
Creosoted block wearing surface	$1.80 per sq. yd.
Bituminous gravel wearing surface	$0.60 per sq. yd.

The average cost of sub-floor and wearing surface per foot of 16-ft. wide roadway (1.78 square yard including curbs) is as follows:

COST OF SUB-FLOOR AND WEARING SURFACE PER FOOT OF BRIDGE

Conc. sub-floor with conc. wearing surface (wt. 100 lb. per sq. ft)	$4.25
Conc. sub-floor with creos. block wearing surface (wt. 65 lb. per sq. ft)	$5.80
Creos. plank sub-floor with creosoted block wearing surface (wt. 32 lb. per sq. ft.)	$7.30
Creos. plank sub-floor with bituminous gravel wearing surface (wt. 26 lb. per sq. ft)	$5.15

It seems probable that under average conditions the length of life of the floors represented by the upper three full line curves of Fig. 4 may equal that of the remainder of the superstructure and that the cost of maintenance for this period would be small.

The experience of the Illinois Highway Department seems to indicate that under average conditions the bituminous wearing surface requires a light treatment of oil and stone chips or screened gravel at intervals of about 4 years at a cost of about 10 cents per square yard and a probable complete resurfacing once in about 12 years at a cost of approximately 60 cents per square yard. This amounts to 7½ cents per square yard per annum. Adding to the first cost of the bridge the maintenance charge capitalized at 6 per cent curve D_1, Fig. 4, results. The position of this curve indicates that it would be preferable to use creosoted block or other floor in building new structures.

EXISTING BRIDGES

Probably 95 per cent of existing steel highway bridges were originally designed for ordinary plank floors. Under average conditions and at the present price of yellow pine, which is the material now quite generally used, the annual cost of maintaining such floors is about 35 cents per square yard. The first cost, plus the maintenance charge capitalized at 6 per cent, results in curve E, Fig 4.

It is evident that ordinary plank floors having an average life of not more than 3½ years are to be avoided when possible.

It is to be noted that with the exception of the floor with the bituminous surface the cost of the floor increases as the weight decreases, and yet the cost of the entire superstructure decreases as the weight of floor decreases.

The saving in cost for the lighter floors increases with an increase in the unit cost of structural steel in place, and decreases with an increase in the cost of the materials used in such floors.

In re-flooring old steel bridges of satisfactory design, a creosoted sub-plank with bituminous wearing surface has been found to give reasonable service. The weight is somewhat greater than that of a plank floor, but the effect of the added weight is probably offset by the reduction of impact, due to the comparatively smooth and yielding surface.

The cost of maintaining the bituminous surface is only about 20 per cent of that of an ordinary plank floor.

There seems to be no place in the economic design of new highway bridges for floors consisting of a creosoted plank subfloor with a brick wearing surface, as the life of such a floor could hardly be greater than that of floor C, Fig. 1, while the cost of the complete superstructure would be greater than that represented by curves B and C, Fig. 4.

The floors listed under class A seem hardly to be justifiable, except for short spans, unless other considerations outweigh first cost.

Concrete Roads

By H. J. KUELLING

Highway Commissioner, Milwaukee County, Wisconsin

A LITTLE too much attention has been paid to thorough rolling of the subgrade of concrete roads rather than to the thorough destruction of the old road surface in order to have a subgrade of uniform density under the new road. In my own work, we did practically no rolling other than that accomplished by traction engines drawing the graders or, in a few cases, by tractors hauling material.

WIDTH AND THICKNESS

My experience has been that where there is a motor traffic of a thousand or more vehicles every day, an 18-ft. road is none too wide; with only a few hundred per day a 16 or possibly a 15-ft. road might be ample. The thickness that I am using on our roads which are 16 and 18 ft. in width is 6 in. at the edges and 8 in. in the middle.

CEMENT

The getting of the proper amount of cement into the road is one of the difficult things to accomplish at the present time, especially where the contractor is inclined to be negligent. This is largely overcome in Milwaukee County by furnishing all cement delivered to the contractor on the job. In this way he has no tendency to slight the proper amount. On the other hand, we hold him responsible within certain degrees for an over-run of cement and also make him responible for the care of all empty sacks.

We prefer a stone graded from ¼ in. to about 1½ in., and of course demand that it be clean and free from any slate, shale or disintegrated stone. In our state we limit the coarse aggregate to material having a French coefficient of wear of 10 or more. In no case would I permit the use of pit run material in the concrete road.

The proportions should be those that will give the greatest density and most homogeneous concrete as can be obtained with the sand and stone obtainable. If the addition of hydrated lime or some other inactive material will tend to assist in obtaining these results without lowering the abrasive value of the concrete it should be included in the proportions. I believe there is a wide field open for careful experiments along this line. At the present time I am using a mix of 1:2:3½. Only in exceptional cases is reinforcement necessary in a country road, these cases being only when springy spots are encountered or possibly where sufficient drainage is impossible due to the swampy nature of the territory.

PLACING AND CURING

For road work proper I prefer a spout to a boom. The main reason for this is that the material is deposited in smaller quantities with, therefore, less tendency toward separation of the aggregate and mortar. Very commonly the boom bucket leaks, and unless careful watch is maintained there is a pile of mortar left at each moving of the machine. Further the boom is additional weight to be carried around, and is often the cause of delaying the work.

The first step in curing is to sprinkle the subgrade in dry weather. We find this is best accomplished by the fireman connecting a small hose to the injector. The next step is to protect the road with canvas in case the temperature is over 90 deg. Fahr. or in case the weather is exceedingly dry and windy. When sufficiently hard, the concrete should be sprinkled and covered with about 2 in. of earth from the side of the road and then kept wet (not in a moist condition) for about 10 days.

JOINTS

The question of joints is the most unsettled one in connection with concrete roads. We have increased our joint spacings from 25 to 35 ft. and from 35 to 50 ft., and at the present time I see no reason for shortening the spacing. I doubt very seriously the necessity for steel protecting plates, for no matter how carefully they are placed there is a tendency to chip, thus demanding an almost immediate tarring of the joints. I believe the joints of the future will be merely felt or paper with a slight rounding of the joint, with an edging tool, which will be filled in by the pounding down of the felt which has been permitted to stick up above the surface. I believe that the ability to get concrete that is homogeneous and impervious to water will have a marked effect upon the spacing of joints as water content is more the cause of the movement in concrete than the changes in temperature.

After trying both gravel and earth shoulders we have practically come to the conclusion that for double-track roads earth shoulders are preferable. We have found that it is not necessary to bevel off the edges of the concrete in order to make the shoulders stay in place and now merely round the edges to a radius of about an inch.

DUMPING TREATED GARBAGE FROM ELLIPTICAL TRACK INTO CLAYHOLE

Emergency Garbage Disposal in Chicago

Acid Treatment in Vats and Burial in Clayholes under Successive Layers of Ashes Proves to Be a Successful Temporary Measure

By Dr. GEORGE B. YOUNG
Commissioner of Health, Chicago, Ill.

OWING to the failure of negotiations between the city of Chicago and the Chicago Reduction Company for the purchase of the garbage reduction works formerly operated under contract by the latter, it became necessary on Oct. 1, 1913, to provide some temporary means of disposal of the city's garbage collection. The City Council voted to place the responsibility for meeting the emergency on the shoulders of the Health Department, although the latter hitherto had nothing whatever to do either with the collection or disposal of any part of the city's waste.

The collection methods followed in Chicago provided for the removal by the city of miscellaneous wastes and ashes from buildings housing less than twenty-one people, and for the collection from similar establishments of the household garbage by means of a separate collection made in wagons with iron bodies. The garbage so collected was transported to the plant of the Chicago Reduction Company for reduction under contract. South of Sixty-fifth Street the collection was a single or combined collection of rubbish and garbage, disposed of by dumping in low land in the extreme southwestern portion of the city in localities where the presence of a dump was unobjectionable. The garbage proper was for the most part transported to the old plant from barge-loading stations on the river, the teams delivering the loaded wagon bodies at these points and receiving empty boxes in place of the loaded ones. The collections from the wards immediately adjacent to the reduction works were delivered by wheel haul.

In performing the duties entrusted to it by the Council, the Health Department selected a site on the North Shore Channel of the Sanitary District, immediately south of Grace Street, the point in question being about 5 miles north and 2½ miles west of the central portion of the city. The locality was one quite isolated, there being no considerable number of dwellings for about 2000 ft. to the east, 1000 ft. to the west and north, and over 2500 ft. to the south. The site was that of an abandoned brick yard, where a clay hole excavation existed 25 to 35 ft. in depth, and extending over an area of several city blocks. The isolation of the location, while of advantage in many respects, was also a disadvantage because of the fact that it was necessary to run in a 6-in. water main for about ½ mile, to construct 600 ft. of heavy railroad track, and to lay ½ mile of electric line both for light and power.

ACID TREATMENT PLANT

The plant consisted of a heavy piling dock, 150 ft. long, of vats for the reception and treatment of the garbage, a track along the river bank for the operation of two 5-ton locomotive cranes, 1200 ft. of light track for the operation of side dump cars, a heating plant, store-house and accessory structures.

Five wooden vats, each with a capacity of over 50 tons of garbage, were erected at the shore edge of the dock. These vats had their bottoms filled in with 12 in. of reinforced concrete. They were provided with 4-in. drain valves on the sides opposite the dock and with connections for filling them with water from the top. The top of the vats, except for an area about 8 ft. square, were covered with decking extended so as to cover all of the space between and around the vats. The space around the bottoms of the vats was cleared and provided with drains for carrying off any fluid which might collect during the process of treatment. These drains were also connected with drains leading down from the decking surrounding the tops of the vats. All drains were provided with connections for flushing out. A two-story wooden structure was erected parallel with the shore side of the vats. The upper story was on a level with the tops of the vats, and provided on one side with doors opening out opposite the opening in each vat, and on the other with windows for light and ventilation. Along the floor was laid a light track upon which ran a small car for transporting carboys of acid used in the treatment. The lower part of the structure entirely inclosed the lower part of the vats and permitted of the operation indoors of the valves draining the vats and supplying flushing water to the drains. A steam radiator consisting of five tiers of 3-in. pipe was hung along the side of the lower story.

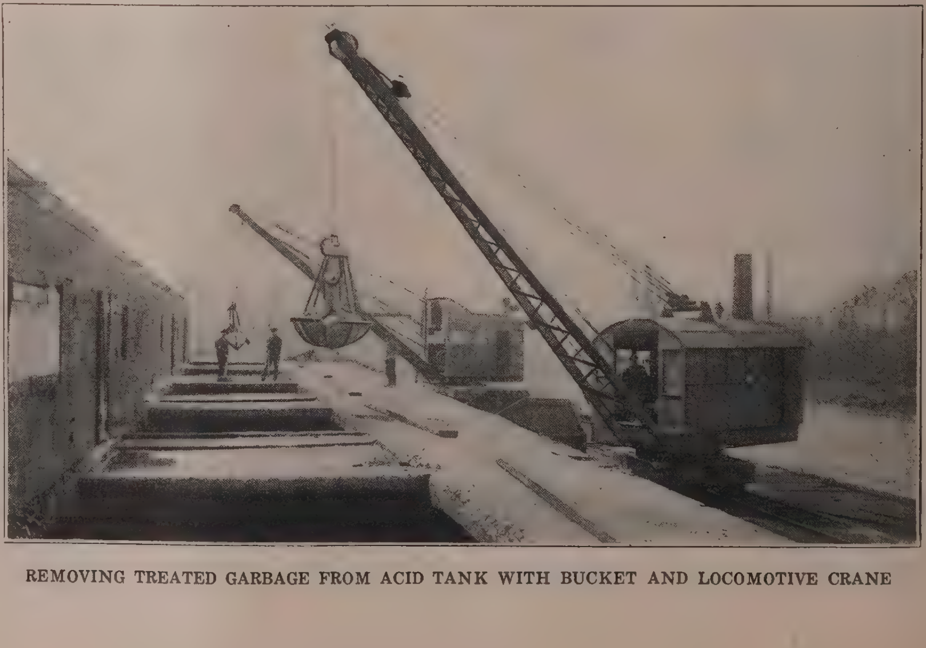
Owing to the fact that during the winter garbage quite commonly freezes solid in the wagon bodies during the period it is on the barges, two iron tanks, 12 ft. long and 8 ft. wide, were installed upon the dock and provided with water and steam connections.

Track, upon which were operated American and Interstate locomotive cranes, was laid immediately along the shore edge of the dock. Between it and the vats ran the lighter dump-car track.

GARBAGE THAWER

A disabled tug boat was secured from the Department of Public Works, made fast to one end of the dock and connected by steam hose with the heating system of the thawing tanks and radiators about the base of the line of vats. In this way an ample supply of steam was secured and no trouble was experienced either in thawing the boxes promptly when received or in preventing the freezing of the material in the vats.

Very great difficulty was experienced in procuring material for the plant, and in its erection. The weather during much of the time was exceedingly bad, with heavy rains and unseasonably low temperature. Especial difficulty was experienced in transporting the cranes from the southern part of the city to the plant. They were knocked down as much as possible, loaded on barges



REMOVING TREATED GARBAGE FROM ACID TANK WITH BUCKET AND LOCOMOTIVE CRANE and transported up the Chicago River and Drainage Canal. Some of the fixed bridges were so low that it was necessary to anchor barges alongside of the abutments and build heavy crib work thereon, cut the rivets for holding the bridge framework to the piers, and then lift the entire bridge structure 8 ft.

The dump-car track was arranged in an ellipse, passing the edge of the clay hole excavation at a point farthest from the vats.

METHOD OF OPERATION

The method of operation was as follows: The iron garbage boxes were picked up by the cranes, immersed in the thawing tanks, swung over the openings in the vats and dumped. They were then returned to the dock, washed out and replaced on the barge. As many vats as were necessary to hold the collection were filled in turn to within 2 ft. of the top. They were then filled with water and sufficient crude hydrochloric acid and crude sulphuric acid added to make a 1 per cent solution of the fluid in the vat, equal parts of each acid being used. The charge was then allowed to remain in the vats until next morning, when the fluid was drawn off through the bottom drains. When the mass was fairly dry, the treated garbage was picked up by the cranes, each operating a $\frac{3}{4}$-yd. Hayward orange-peel bucket. The buckets deposited the garbage in wooden side dump cars. These were then drawn around the track by horse power to the opposite edge of the excavation, where they were discharged through wooden chutes into the excavation.

SPREADING IN LAYERS

A gang of men with wheelbarrows working on running boards then distributed the garbage over the bottom of the excavation, in a layer about a foot thick. This process was carried on during the day time, while the city ash wagons delivered their loads at the edge of the excavation. During the night the wheelbarrow gangs distributed the ashes over the top of the garbage in a layer about 18 or 24 in. thick.

Originally it was the intention to discontinue the operation of the temporary disposal station April 1, as it was hoped that the repairs to the reduction plant, which in the meantime had been purchased by the city, would be completed by that time. It was necessary, however, to continue the operation until the middle of June.

EXCAVATIONS INDICATE TREATMENT SATISFACTORY

In round numbers 60,000 tons of garbage were handled during the time the plant was in operation. For the purpose for which the plant was intended it was entirely successful. The treatment by acid simply arrested decomposition of the garbage long enough to permit the overlayer of ashes to become thoroughly compacted and mixed with the garbage. Toward the latter part of our period of operation we had very great difficulty on account of the falling off in the amount of ashes collected, and also because the long period of operation had resulted in the complete filling in of the area of the clay hole near enough to the plant to be available economically. The treated mass sank altogether about 9 ft. After each period of gradual subsidence it was filled up again to grade. Last spring 4 to 5 ft. excavations were made over a considerable portion of the filled area and the excavated material was used as cover for the fresh charges of garbage. This excavated material was absolutely dry and inoffensive, and, except for the presence of an occasional dried orange peel or similar fragment, it would have been impossible to tell that the mass being handled had been made up, to fully 50 per cent of its bulk, of freshly collected garbage.

We learned a good many things in the line of handling garbage under emergency conditions during the time that the plant was in operation, and while, of course, the method is only an emergency one, we have no reason to be dissatisfied with the result.

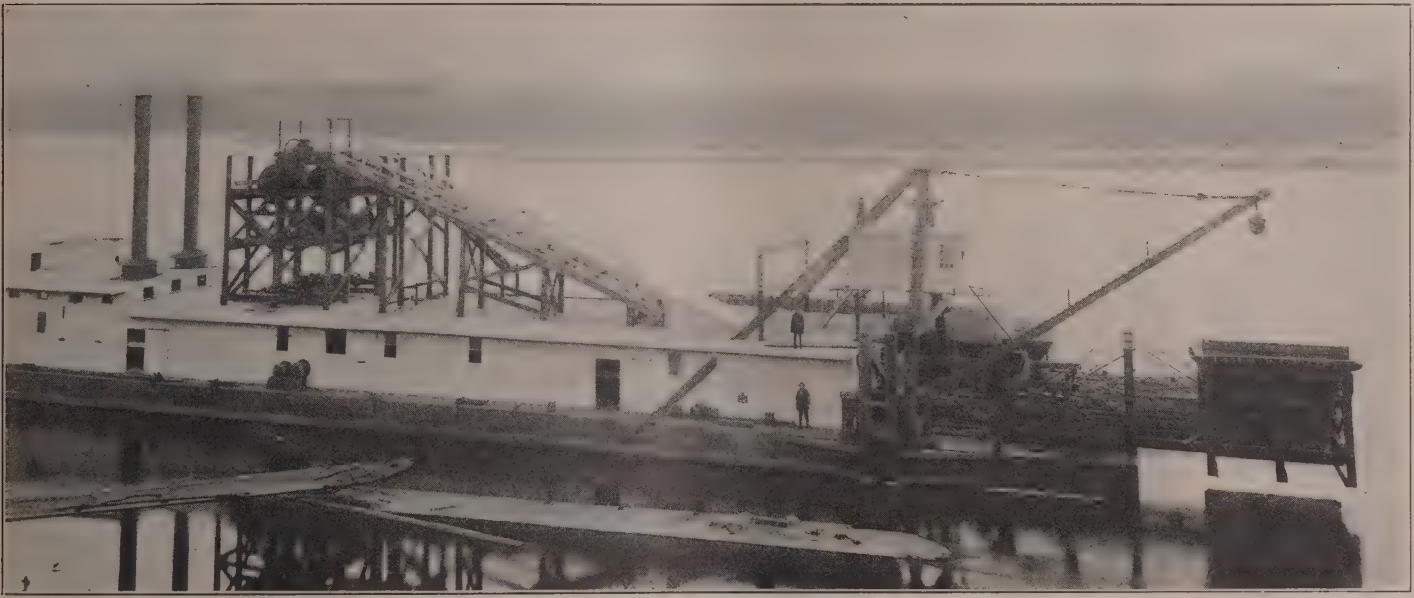
THE TOTAL DRAINAGE AREA of the St. Lawrence River below the mouth of the Oswegatchie River is approximately 383,000 sq. mi., according to Water Supply Paper 324, recently issued by the U. S. Geological Survey. Of this area 95,600 sq. mi., or nearly 25 per cent, is water surface. The mean annual flow at Ogdensburg is about 252,000 sec.-ft. The mean annual flow of the Ohio River is about 300,000 sec.-ft.

Large Floating Gravel-Washing Plant in Indiana

Description of Construction, Equipment and Operation of What is Said to Be the Largest Plant of Its Kind

WHAT is said to be the largest floating gravel washing plant in the world has recently been built for E. T. Slider of New Albany, Ind. The maximum capacity of the plant is 300 cu. yd. per hour.

The plant equipment is mounted on a dredge boat 225 ft. long having a 36-ft. beam and a depth of $6\frac{1}{2}$ ft. The boat draws 27 in. of water for running light and 32 in. when coaled and loaded for service. Digging is accomplished by means of a 3-yd. orange-peel bucket operated by a double 13 x 18-in. Hayward excavator engine. The operating levers are all located in an operator's room 16 ft. above the deck. The bucket is connected by 1-in. close-link dredge chains.



SIDE VIEW OF FLOATING GRAVEL-WASHING PLANT, SHOWING DEWATERING HOPPER AT RIGHT

Material is dumped from the bucket into a special dewatering hopper, 14 ft. wide and 19 ft. long, and fed by a counter-weighted feeding gate onto a 36-in. troughed belt conveyor. It is then delivered by the conveyor into a bifurcated spout discharging into two conical triple-jacketed washing screens. Fine gravel is separated from the sand by means of conical sand screens, 60 x 84 x 96 in., mounted directly beneath the gravel screens. The spout arrangement from the screens to the two loading conveyors is said to be unusual in that the gravel sized from the various screen jackets can be brought together into several different combinations. The hopper overhangs 18 ft. from the end of the boat in order to prevent wasted material from falling on the deck. The main 36-in., 150-ft. belt conveyor is made of high-grade rubber with a $\frac{1}{8}$-in. extra rubber cover on the carrying side and is equipped with pressed-steel troughing idler rolls spaced about 3-ft. 9-in. centers.

LOADING SYSTEM

Loading is accomplished by means of a 24-in. belt conveyor in the case of the fine gravel and a 30-in. conveyor for the coarser material. Gravel is loaded on the scows, one of which is moored directly against the dredge and the other just beyond the first. The sand scow is on the opposite side.

Both the screens and the belt conveyors are driven by a double 10 x 14-in. engine connected by a rope drive to a jack shaft, from which the screens are driven by heavy steel chains. The oversize stone is spouted down to a 36-in. Symond's disk crusher and the crushed stone is carried back to the screens for rescreening by a bucket elevator. A 7-in. centrifugal pump furnishes wash water for the screens.

Four 40-ft. spuds provided with heavy steel shoes on the ends hold the dredge in position. They are operated by four 6 x 6-in. direct-connected engines with racks and pinions.

The boiler equipment consists of two 66-in., 16-ft., 100-hp boilers built to operate at 150 lb. pressure, and so arranged that each boiler setting is an independent unit. In front of each boiler an ash well is located for dropping the ashes into the water. An electric lighting plant operated by a small 7 x 10-in. engine furnishes lighting for the dredge. Coal is placed in bunkers by the main conveying system. The dredge is provided with quarters for housing and feeding the operating crew. As the barge is 225 ft. long the tendency to buckle is done away with by the usual method of hog chaining.

The plant was designed by Mr. Slider, the owner, and by the engineers of the Raymond W. Dull Company, of Chicago, who furnished the conveying and screening equipment.

Erecting Railroad Viaduct Superstructure

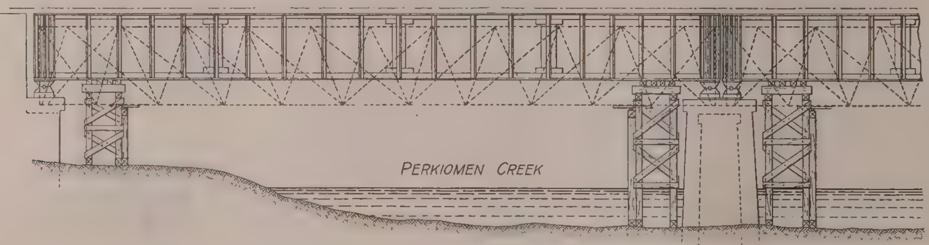
Different Methods Employed for Replacing Truss Spans by Plate-Girder Spans Using Derrick Cars, Derricks and Falsework Towers

THE variations developed in the application of substantially standard methods of erection to the renewals of railroad viaducts under traffic include more numerous modifications and adaptations of ordinary plant and operation than might at first be expected in simple work. A few of them here described show how short truss spans on two different lines of railroad were replaced by plate-girders by the use of derrick cars, derricks and falsework methods and combinations varying radically in each case, all conducted without interruption to traffic.

Erection by Hand Derrick

Bridge 43, south of Palm, Pa., is a single-track structure, supported on two masonry abutments with a skew of 13 to 20 over the highway. The old through lattice girders 6 ft. deep, 64 ft. long and 13 ft. apart on centers carried wooden floorbeams supported on the bottom chords, as indicated by the dotted lines in the diagram. They were replaced by slightly shallower plate girders 62 ft. 3½ in. long on the same center line, with steel floorbeams and stringers carrying the track at the original elevation.

Two framed and braced trestle bents with double caps were erected 6 ft. apart, parallel with the abutments, at each end of the span, leaving a clearance of 12 ft. normal to the axis of the highway between them in the center of the span, and thus providing for traffic under the bridge during the new construction. Between trains the old stringers and floorbeams were replaced by temporary stringers supporting the rails and old ties on the falsework bents. At the ends of the span the stringers consisted of two 10 x 16-in. timbers 20 ft. long under each rail; over the center opening two 18-in. 55-lb. I-beams, 28 ft. long, were placed under each rail. The pairs of I-beams were braced together by two transverse cross-frames, each consisting of two 6 x 8-in. horizontal struts and two 1-in. horizontal screw-end tie rods.

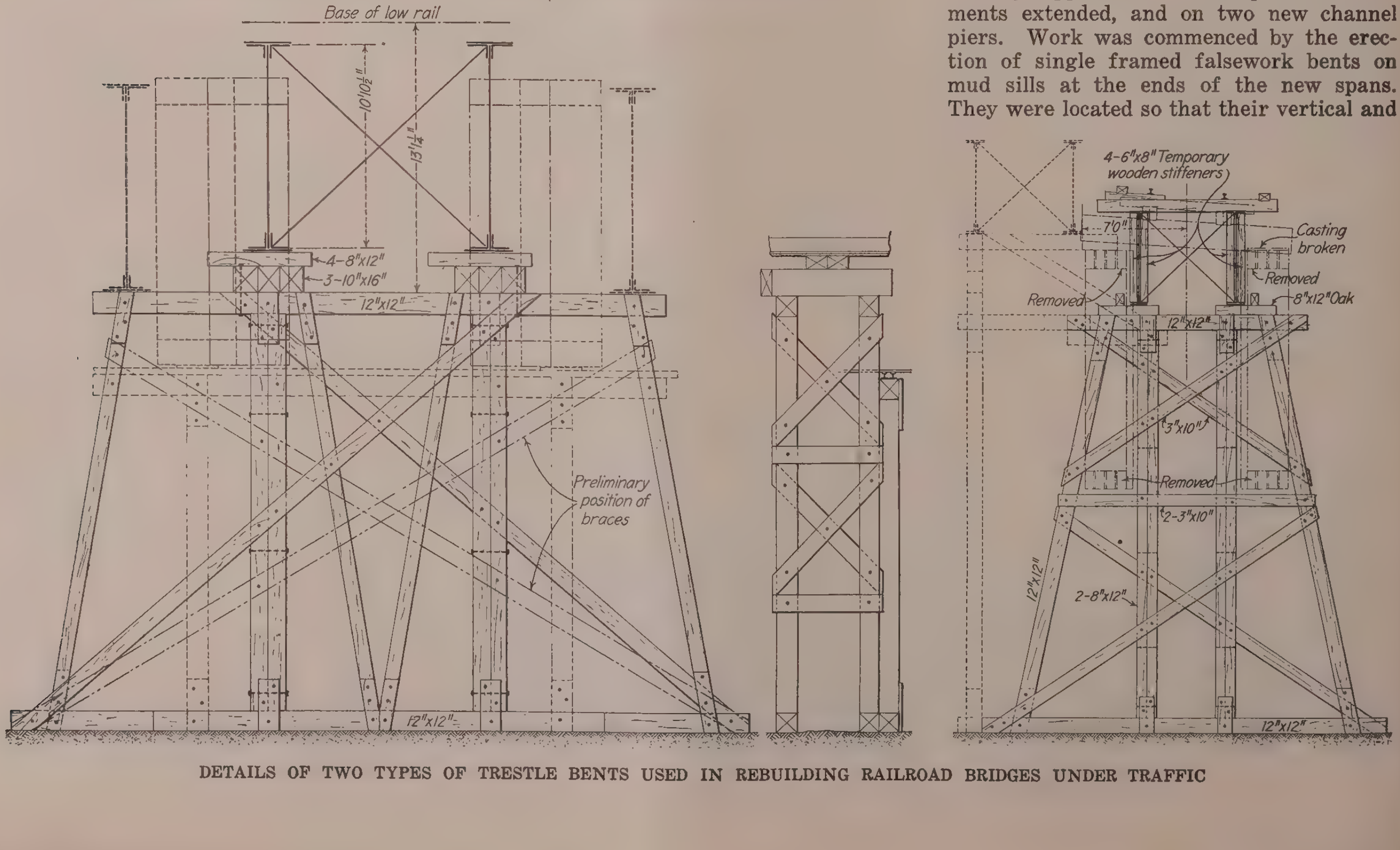


FALSEWORK TOWERS UNDER ENDS OF SPANS, PERKIOMEN CREEK BRIDGE

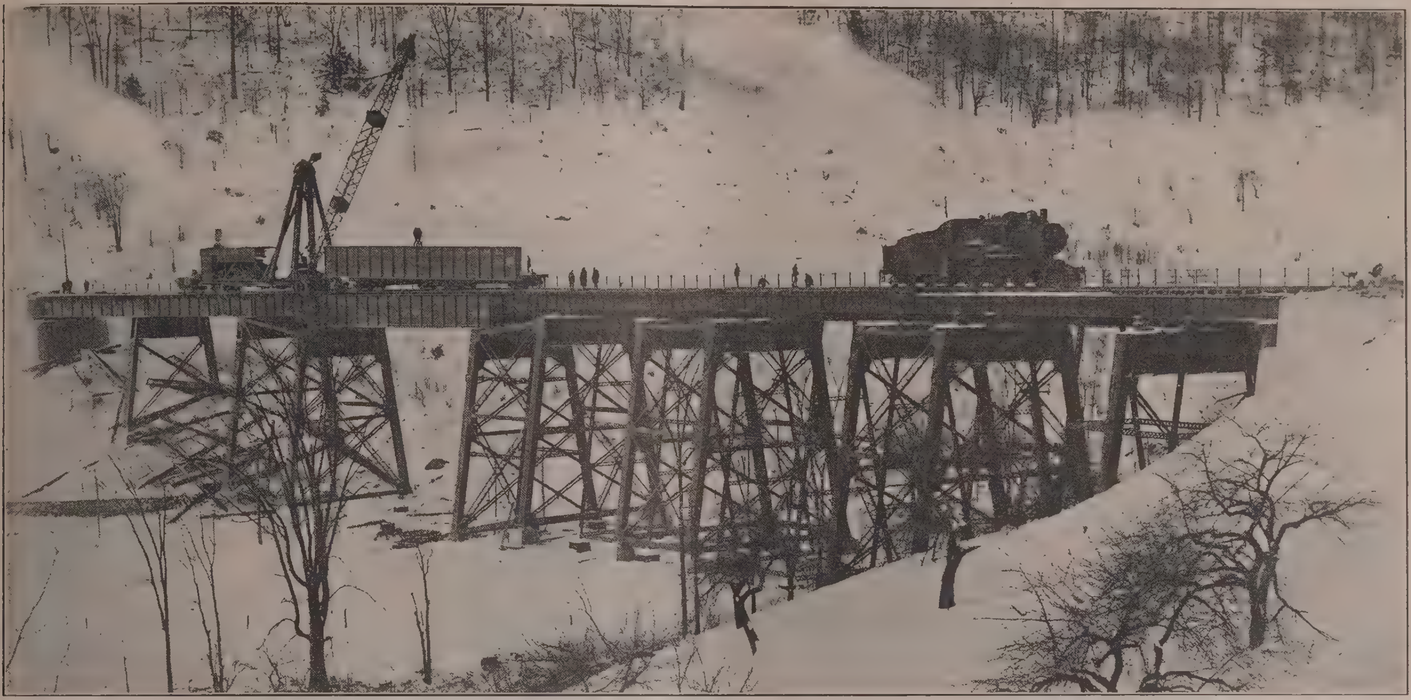
On one abutment there was installed a 20-ton derrick with one stiffleg transverse to the bridge axis, two guys parallel to it, and a 60-ft. boom operated by a four-man windlass. The derrick removed the old trusses piecemeal and then unloaded the new 14-ton plate girders from cars run over the falsework, and lowered them to position on the abutments. Subsequently in intervals between trains the falsework stringers were removed one panel at a time, and the permanent floorbeams and stringers were assembled in position, service bolted, and the tracks transferred to them, after which the field riveting was done at convenience. The floor was changed in 3 hours, and the work completed by removing the falsework. The work was done in ten days by a force varying from six to ten men and a foreman.

Supporting and Separating Old Trusses on Falsework Towers

The two-span trussed superstructure of the Hosensack Creek bridge was replaced by four deck-plate-girder-spans about 50 to 55 ft. long supported on the old pier and abutments extended, and on two new channel piers. Work was commenced by the erection of single framed falsework bents on mud sills at the ends of the new spans. They were located so that their vertical and



DETAILS OF TWO TYPES OF TRESTLE BENTS USED IN REBUILDING RAILROAD BRIDGES UNDER TRAFFIC



60-TON ERECTING CAR EQUIPPED WITH LONG DERRICK BOOM HANDLING GIRDERS FOR CADOSIA VIADUCT

batter posts cleared the bottom chords of the old trusses. The caps were about 4 ft. below the top chords of the old trusses and cleared their diagonal members. Temporary vertical posts seated on one end of the old sills, clear of the batter posts, were braced to the caps and extended above them to support one end of temporary horizontal transverse timbers which were carried at the other end on the top chord of the old truss.

The 25-ton completely-braced new spans were delivered by derrick cars running on the old bridge, and placed by them on the falsework in temporary position, indicated by dotted lines, just clearing the traffic on the old bridge. Traffic on the old bridge was then suspended for about six hours, during which interval the floor and transverse bracing and the inner pieces of the chord timbers were removed from one old span, affording clearance for the new span on the same center line. A derrick car with 38-ft. boom then lifted one of the new spans from its position alongside and seated it in permanent position on the falsework between the old trusses; new track was laid on it at a little higher grade than on the old span, and the derrick car advanced to the end of the span and set the next span in the same manner.

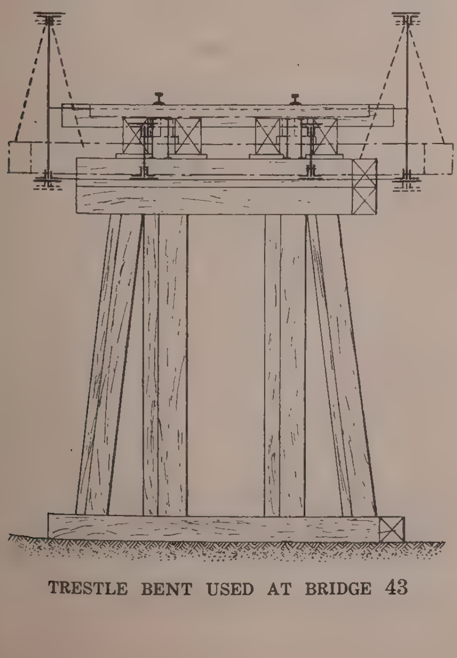
Afterward the same operations were repeated for the renewal of the other old span. Subsequently the old trusses were removed, the pier and abutment masonry were completed, and the falsework was taken down. Provision was made for the reaction of the derrick car by placing a set of transverse I-beams under the forward truck in position to handle the span and block up to the I-beams from the falsework bents.

ERECTING GIRDERS ON FALSEWORK TOWERS

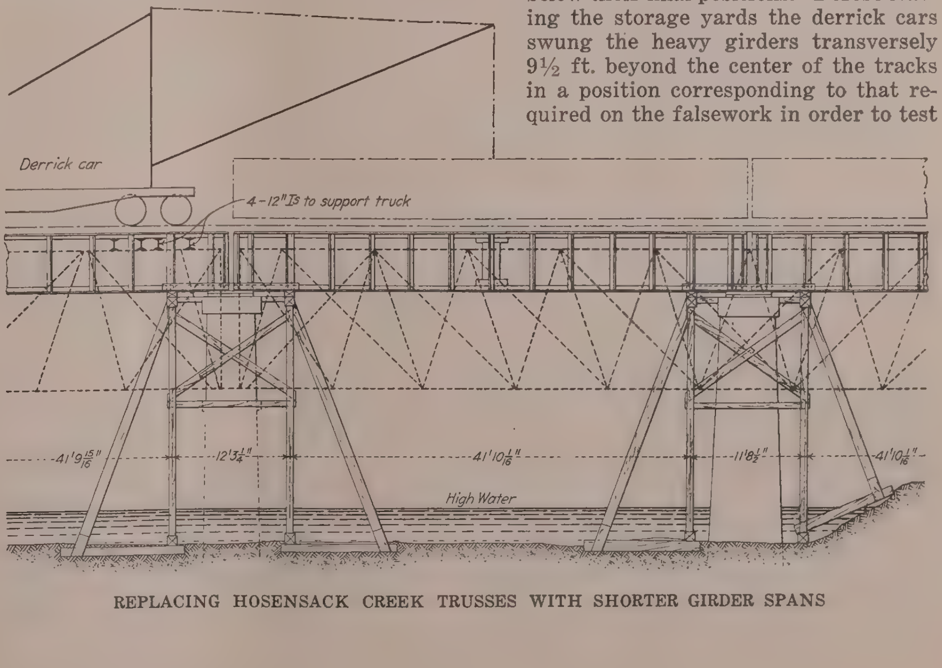
The replacement of the three-span single-track Perkiomen Creek Bridge at Spring Mount, Pa., was effected by the construction of falsework towers under each end of each span, placing the new plate girders on them alongside the old structure, supporting the old trusses and moving them transversely far enough apart to permit the girders to be shifted to their permanent position between them, transferring traffic to the latter, dropping the old truss into the creek, and removing the falsework.

The skewed truss spans from about 99 to 103 ft. long had masonry piers and were 28 ft. high from base of rail to water level. Framed falsework towers with mud sills parallel to the stream, were erected under each end of each span, on shore and in water 10 or 12 ft. deep. The two main caps of each tower were above the lower chords of the old trusses and cleared their diagonal members. Each tower had a third bent with two vertical posts carrying a transverse cap, clear of the underside of the old bottom chord, which later received the weight of the old span.

The new girders weighing about 38 tons each, were unloaded at the site by two derrick cars each, which carried them out over the old structure and seated them on the upper caps of the falsework towers just outside the old trusses, in temporary positions, 18½ ft. apart on centers and about 2 ft. below their final positions. Before leaving the storage yards the derrick cars swung the heavy girders transversely 9½ ft. beyond the center of the tracks in a position corresponding to that required on the falsework in order to test



TRESTLE BENT USED AT BRIDGE 43



REPLACING HOSENSACK CREEK TRUSSES WITH SHORTER GIRDER SPANS the derrick-car stability. The girders were then swung back to the center line of the track for transportation, and the derrick cars were blocked up and securely anchored in position before the girders were swung to place on the falsework.

REMOVING OLD SPANS

As the work was originally planned the old trusses were to be jacked up and lowered to bearing on 12-in. plates inserted between their bottom chords and greased rails on the falsework caps. Traffic was to be suspended, the floor removed from a single span, the cross bracing cut apart and the trusses jacked transversely from the center line until a clearance of 10 ft. 4 in. was provided between them for the new span and they were temporarily braced in position.

This plan was modified when the work was executed and the girders were placed temporarily outside the old trusses. The latter were picked up by the derrick cars, after the removal of the old wooden floor, and were lifted over the girders and dropped into the creek.

All of the bridges above described are on the Perkiomen line of the Philadelphia & Reading Railroad. The steelwork was fabricated and erected by the Phoenix Bridge Company, of which John Sterling Deans is chief engineer and R. S. Foulds is erecting engineer.

REPLACING SINGLE TRACK VIADUCTS

Single-track truss spans on the New York, Ontario & Western Railway have been recently replaced by double-track plate-girder spans erected by locomotive cranes and derrick cars unloading, storing, and handling material, and moving on the completed structure alongside the operation tracks until one of the new tracks was ready for service and traffic diverted to it, permitting the adjacent old structure to be removed and the second track to be installed.

The Carbondale viaduct, about 1500 ft. long and 35 ft. high, consists chiefly of plate-girder spans from 32 to 89 ft. long, carried partly on masonry piers and partly on steel towers. Double-web transverse girders are seated on the tower columns and carry four lines of 25-ton longitudinal girders supported on their top flanges. The erection was done by a 40-ton locomotive crane.

The Cadosia viaduct, 65 ft. high, has eleven spans of plate girders of a maximum length of 85 ft. and weight of 28 tons. A 40-ton locomotive crane unloaded, stored and delivered the steel to the 60-ton erecting car equipped with a long steel derrick boom and topping lift connected to a wooden transverse vertical frame. Field rivets were driven by pneumatic hammers operated from a compressor car. The viaduct weighed 1065 tons and was erected by twenty men in forty days. Both this viaduct and the Carbondale viaduct were erected by the Lucius Engineering Company, Pittsburgh.

TRIMMING MUNICIPAL EXPENSES to meet the actual income, which fell $45,000 under the estimates, was easily accomplished recently at Dayton, according to Henry M. Waite, City Manager, at the City Managers' Conference in Springfield, Ohio, by lopping off loose odds and ends of various departments, such as repairing old wagons in the street department instead of purchasing new ones. No department was crippled and no service was appreciably curtailed.

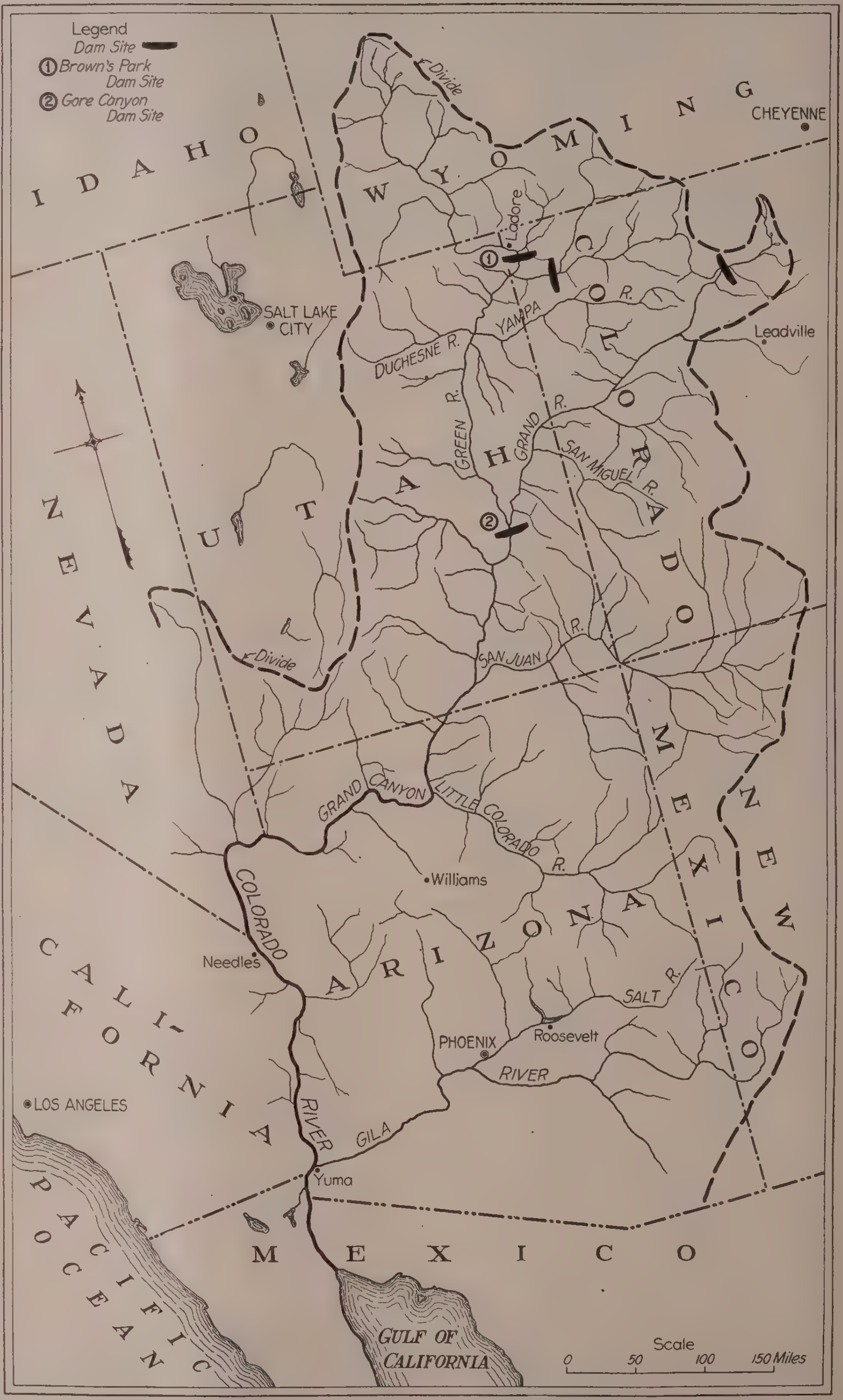
Reservoir Sites on the Colorado River

Conditions That Affect the Reclamation Service Survey Now Under Way

By LOUIS C. HILL
Consulting Engineer, U. S. Reclamation Service

PROBABLY the fairest plan for distributing the waters of the Colorado River system, as well as the one from which the United States as a whole will derive the greatest benefit, involves provision for irrigation of all suitable land in Wyoming, Colorado, Nevada and Utah, as well as that along the river in Arizona and California, and such lands in Mexico as the available water can serve, or as a treaty between Mexico and the United States may stipulate.

This plan will involve storage of all surplus water of the system in large reservoirs having not only a combined capacity sufficient to supply water to the irrigated land during the low-water period of each season, but also sufficient additional capacity to carry over a supply from a year of large runoff to one of small runoff. In addition to these requirements the reservoirs should have additional capacity sufficient to permit of excess flood regulation. Each reservoir constructed would tend to reduce the peak of the flood. If one year of extreme runoff was immediately followed by another nearly or quite as high, the



MAP OF COLORADO VALLEY, SHOWING VARIOUS POSSIBLE RESERVOIR SITES total runoff for the second year might not be greatly different from what it would have been if the reservoirs were not in existence, yet the peak of the flood would be greatly flattened.

POSSIBLE RESERVOIR SITES

There are a number of locations suitable for large reservoirs on the tributaries of the upper Colorado River. Some of these sites, such as the Brown's Park reservoir and the Kremmling reservoir, have been fairly well investigated. The dam site at either of the foregoing is so favorably located that nothing but the strength of the materials used need limit the height and hence the storage capacity.

Both dam sites are in deep canyons with nearly vertical sides. The rock is most excellent for foundations and abutments at both places, being a hard quartzite (much like the best of the rock at Roosevelt) at the Green River site in Ladore Canyon and a good granite at the Gore Canyon site on the Grand River. Both dams will be arched in plan. The total storage to be provided at these sites may be as large as any study of the Colorado system may show to be advisable, and there will also be ample capacity for all the silt brought down by these streams for hundreds of years.

There are two large reservoir sites on the Yampa, a tributary of the Green entering it below Brown's Park. The Yampa is a clear stream averaging nearly 1,000,000 acre-feet annually. One of these proposed reservoirs is large enough to store the entire average flow for two or more years.

Another possible site of a large reservoir is just below the junction of the Grand and Green Rivers. No borings have been made, but providing these prove favorable, a very valuable distributing reservoir may be developed here even if the capacity proves to be less than that of the Brown's Park reservoir.

The San Juan, a large stream entering the Colorado some distance below the junction of Green and Grand Rivers, carries a large flow and has at least one large reservoir site. Two other large streams, the San Miguel in Colorado and the Duchesne in Utah, have large runoffs, but no investigations have yet been made as to the storage possibilities along their lower valleys. Further down, the Virgin River comes in from the north and the Little Colorado from the south. The latter stream is rather erratic in character, and the private development going on upon it will result in time in materially altering its effect on the Colorado.

THE RESERVOIR SUPPLY

The economical use of water from the tributaries of the Colorado for the irrigation of such land in Wyoming, Colorado and Utah as is and can be served readily would benefit the lower lands if adequate storage were provided. Below Needles the river usually carries more water than will be needed for irrigation during the months of April, May, June and July, and less than will be called for after development of the full irrigable area below the canyon during the other months.

The lands irrigated from the headwaters usually take no water before April or May, and do not need it after September. Their greatest demand, therefore, coincides with the maximum discharge of the lower river, and hence the maximum waste below Needles. The use by these higher lands during most of this period would reduce the flood flow and would be a benefit to lands lower down in Colorado. During the latter part of the irrigation season these irrigated lands that take water from the tributaries would need to be served by stored water.

EFFECT OF RETURN SEEPAGE

Such return seepage as would appear after a few years from these irrigated lands would tend to equalize the flow. The lands would absorb more water during the irrigating season than they would return, but the return flow would continue during the entire non-irrigating season, which also happens to be the low-water season on the lower river. The tendency, therefore, would be to decrease the flow during high water and to increase it during low water, except during the months of August and September and possibly part of July, when the demand from the upper lands would materially exceed the return seepage from these lands.

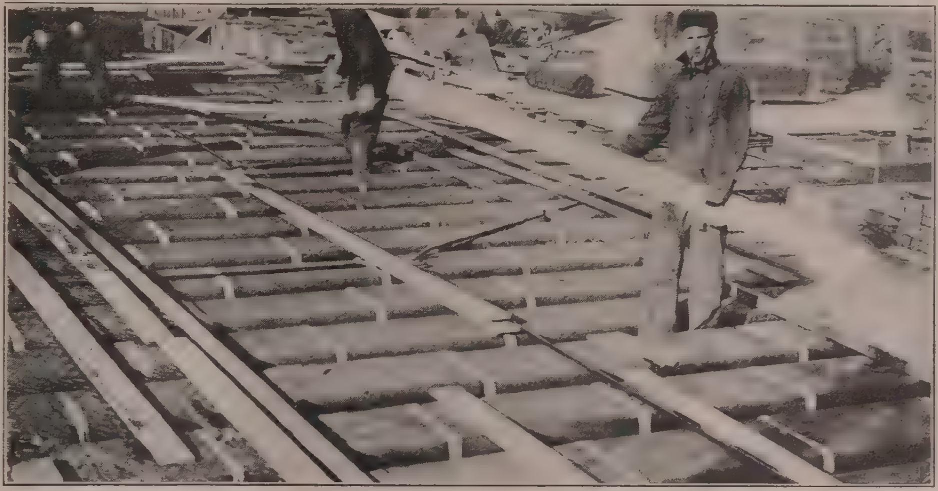
From the Grand Canyon to its mouth the Colorado generally flows between alluvial bottom lands. The river wanders from side to side of the valley and no bottom land under present conditions is safe from loss by erosion, inundation or both, unless protected by well built levees. Even when so protected these lands are not made safe under the present unregulated condition of river flow unless the greatest watchfulness and care is exercised. The changes in length due to changes in channel between controlling points along the river results in changes in elevation of the river bed and has continually caused seepage troubles against which ordinary drainage systems may hardly be considered an adequate protection.

When the canal systems now in use below the Grand Canyon are supplying all the lands which they serve, practically the entire low-water flow is taken from the river. Because this prevents extension of the irrigated area, and because of the urgent necessity of relieving the flood danger in the lower Colorado valley, steps are now being taken by the Reclamation Service to remedy present conditions.

As reported in the "Current News" of the Engineering Record of May 23, the Secretary of the Interior has set aside $50,000 for a preliminary report for this great problem, and parties are now in the field gathering data.

Plasterboard Domes as Fillers for Concrete Joist Floors

DOMES of plasterboard for use as fillers for concrete joist floors, as described in the "Current News" of the Engineering Record of Oct. 31, page 226, were recently installed at Streator, Ill., at a cost of 1.3 cents per square foot for the first floor, this figure including setting the suspended ceiling. The contractor asserts, however, that he can set the second floor, after understanding the new material better, for less than a cent per square foot. On account of the insulating properties of the Sackett board domes it was found unnecessary to heat the under side of the floor, although salamanders are used on top. The open formwork was used, with 4 x 4-in. posts and 4 x 4-in. stringers, on top of which were placed 1 x 6-in. strips laid flat. This was said to be cheaper to install than the solid floor necessary for clay tile filler, and as there was a difference in weight of more than 20 lb. per square foot it was possible to space the struts farther apart and thus minimize the amount of lumber used. Cheesecloth strips were used at the end joints to prevent wet concrete from getting in. Due to the ease of installing pipe work the plumbing and electrical contractors were each enabled to reduce their bids $200. The Sackett board domes used are manufactured by the United States Gypsum Company, of Chicago.



PLASTERBOARD DOMES IN POSITION IN FLOOR UNDER CONSTRUCTION

Training for City Managers

Henry M. Waite Mentions Some of the Qualifications for Municipal Executives and Discusses the Selection of Employees

THE city manager form of government is the application of business methods to the operation of a city. The fundamental training of a city manager, as explained by Henry M. Waite, city manager of Dayton, in a paper presented at the recent conference of city managers in Springfield, Ill., is the same as the training of any manager of large affairs. He does not have to be an engineer, according to Mr. Waite. In many American cities the engineering problems are the most important to-day, but any good executive can be a good city manager. Cities desiring city managers should select the one whose previous training will best meet the requirements of every community.

A city manager should have at least a fair education, sufficient theory, but not too much to overbalance practicability. He must be an executive. He must know how to handle men. He must be fair and just. He must be firm but polite. He must have the courage of his convictions. Any man with these qualifications can be a city manager. Such a man can select subordinates and advisors to aid him in carrying out the functions of those departments with which he is not familiar in detail.

PRODUCING EFFICIENCY

As an executive he must get efficiency from all his departments by organization. This is what we have always attempted to accomplish in our old forms of municipal government. We found, however, that we could not select them through the ballot. This is where the straight commission form of government is failing, as it attempts to select trained men for principal functions through the ballot, and also attempts to combine the legislative and the administrative functions.

Young men contemplating the city manager as a profession feel that they must be employed in a city where this form is in effect. This is not true. A young man with eyes and ears open and ambitious can learn more in a mis-governed city than in a well governed city. They should go into the service in their own communities—other communities have their own young men to draw from. Every good and perfect organization has an understudy for every position. Work this out in your own organization.

PERSONNEL

Get young, honest, intelligent men in your organization. This can be done under the city manager form of government. You have the entire city to draw from or the whole country, if necessary, and are not hampered by trying to take your appointees from one political party. Take advantage of this fact and you assure the success of your administration. Mr. Waite has found such men in the service under the old form of government, anxious to get ahead, but they have been hampered by the old order of things. Keep them. Back them up and weed out the weak ones. If each of us will so organize, the question of supplying city managers solves itself.

There is in communities a feeling against the employment of out-of-town men for city managers. This is usually the harping of the old faithful in the ranks of the political parties. A perfected organization can usually be attained quicker by selecting a manager from out of town, as he is not hampered by the local traditions.

VALUE OF PUBLICITY

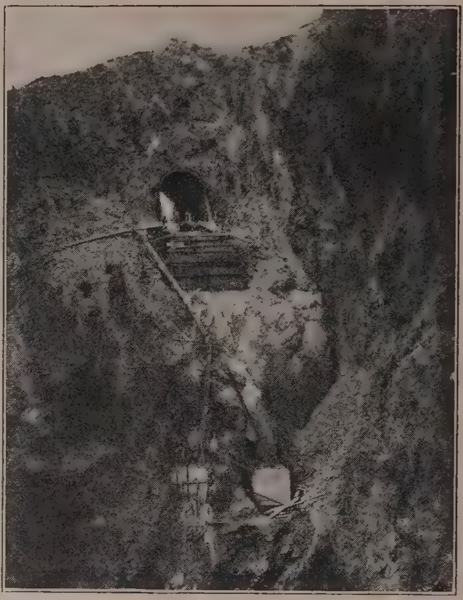
Too much stress cannot be laid on the import of publicity. Under the old forms of government only such publicity was given as would best meet the ends of the particular parties in power. The new forms of government must give to the citizens constructive publicity. We must educate the people to the advantages which they are receiving from the new forms of efficient government. Under the old order of things as soon as one party was elected into power, the public were immediately put through a course of education as to why that party should be out of power. The result has been that the notion is inbred for change. Every two years the citizenship becomes restless for change. This can only be overcome by education and constructive publicity.

Construction Progress on Canadian Northern Pacific

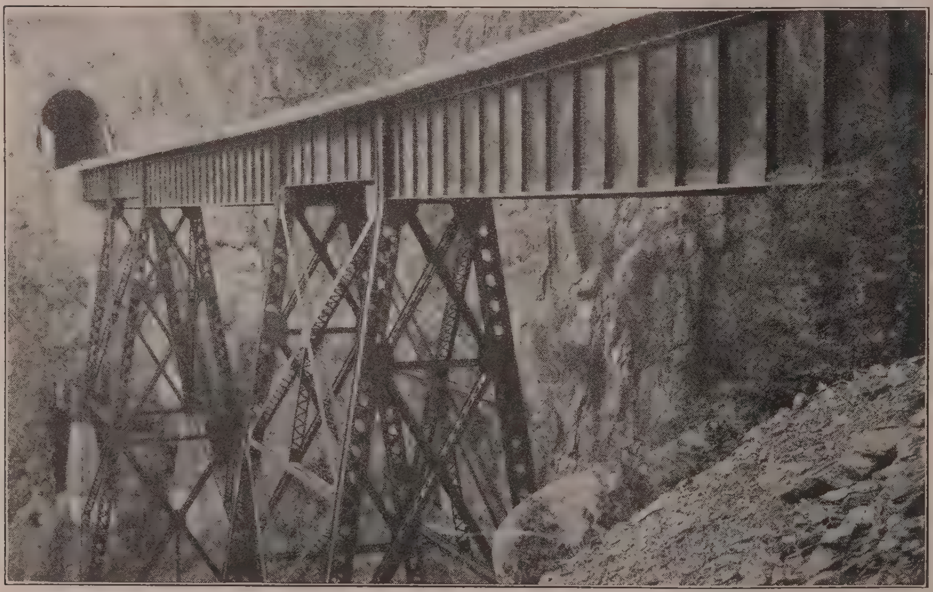
Tracklaying Had Advanced, October 1, 123 Miles from Vancouver and 48 Miles from Yellowhead Pass, Leaving Gap of 86 Miles

NEARLY all the important bridges on the Canadian Northern Pacific Railroad in British Columbia had been completed on Oct. 1, but the few canyons still unbridged are delaying the grading in the gap which has not yet been finished, and it will probably not be possible to drive the last spike until some time after the first of the year. Tracklaying gangs working east from Vancouver had advanced to a point 123 mi north of the Kamloops on Oct. 1, and at that time the westbound gangs had carried the railhead to Mile 48 west of Yellowhead Pass, so that an 86-mi. gap remained to be completed.

There is a total of about fifty bridges and trestles on the main line within the borders of British Columbia, of which the ten largest are in a class by themselves as structures of considerable importance, while the next nine are viaducts or shorter-span steel bridges, and the remaining thirty trestled or short bridges of various types.



POURING CONCRETE IN PIER FOOTINGS



COMPLETED BRIDGE OVER NINE-MILE CREEK ON CANADIAN NORTHERN PACIFIC

The accompanying photographs show one of the second or viaduct-class structures during and after construction. This is Bridge 14 across Nine Mile Creek, 18 mi. west of Lytton, B. C. It is 300 ft. long, has a maximum height of 129 ft. and consists of two 90-ft. and three 40-ft. girder spans. The concrete abutments and tower footings were poured through wooden troughs from the tunnel portal, the mix being hoisted from a floating plant moored on the river bank below.

Efficient Use for Surplus Blueprints

Engineering Employees of Large Company Seize Chance Offered to Look "Void" Prints Over and Save Such as They Desire

By FRANK H. JONES
Winter Hill, Mass.

IN connection with the office work of a large Eastern manufacturing and contracting company the problem of the disposal of canceled blueprints was worked out in a manner that at once recommended its adoption for the use of a number of large shops, corporations and engineering firms. Nearly every month a clearing out of the blueprint files resulted in throwing away hundreds of prints and sketches as obsolete issues or abandoned schemes. To put this great mass of valuable data into the waste basket without any attempt whatever to extract even a small per cent of its value seemed to the writer sheer waste of good material.

After carefully considering the many features of this practice, the monthly harvest of canceled blueprints was gathered into one place—each print stamped "VOID" and the whole lot placed on a broad shelf in the storeroom, after which each designer, draftsman and engineer employed by the company was invited to pick over and take out such prints as he wished to keep for himself—the only consideration being that he would take them from the office or keep them in such a manner as not to litter up the office or his desk by their presence. The response to this invitation indeed attests the value of such a scheme, for practically all of the employees availed themselves of the opportunity to preserve copies of their own work or details of design of interest in their own special lines. One enterprising squad even started "The Scrapheap Scrapbook" into which they pasted clippings from the prints, properly indexed, of interesting designing details.

From the point of view of the employee the practice flavors of the co-operative spirit of the firm in placing at his disposal everything it can of interest to the work at hand. The firm, whether it be a machine shop or a civil-engineering office, can by this and similar methods create a lasting and beneficial impression by their interest in these little things. This spirit of interest in the work is noticeably different from that in the office of the firm that flatly refuses to share its benefits from the experimental and practical work with the men who create them.

Closely allied with this practice is the disposal of catalogs, trade literature and extra specifications. The same general method can be used for these otherwise wasted things and the spirit of teamwork induced by such a service far more than repays the small outlay of time and labor necessary. It is but a step from this practice to a complete and efficient service that may be rendered by a properly organized library department, the service of which may prove not only interesting and unique but indispensable to the best interests of co-operative work.

THE EAST EMERGENCY DAM at Gatun Locks, according to the "Canal Record," has been tested under full water pressure due to a 45-ft. head on its upstream side. The greatest leakage occurred at the bottom, principally at the pockets in the sill for the ends of the girders. After the culverts from the lock chamber had been closed the leakage was measured and found to be 950 sec.-ft. The water surface below the dam rose 5 ft. in the first 10 min. and the lock chamber filled in 2 hr. 50 min. The chamber was the 400-ft. section, and it is estimated that it would have taken seven hours to fill the 1000-ft. chamber. Measurements on the horizontal trusses indicated a deflection of 0.097 ft. due to the full head.

Concrete Handrails on Kansas City Terminal Work

Unit Construction with Spindles, Posts and Rails, Cast at a Central Plant, Used in Protecting 1¾ Miles of Viaducts

BUILT-UP handrails of reinforced concrete cast in wooden molds at a central plant are used on 1¾ mi. of the viaducts of the Kansas City Terminal Railway Company carrying street traffic. In addition there are more than 5 mi. of subways and retaining walls surmounted by pipe rails. Much study was given to the design of the handrail following the casting of the first members. Suggestions by the contractor and the engineers resulted in nearly a dozen revisions of the first plans, all tending toward simplification of construction and improvement of minor points in the design.

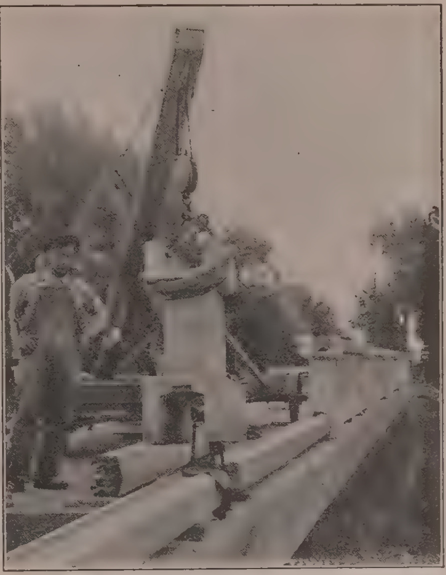
The railing consists of a top and bottom rail set parallel to the pavement and grooved to receive the 3¾ x 5-in. spindles, which are set truly vertical, regardless of the grade of the rails. For this purpose the tops and bottoms of the spindles are shaped to the required angle.

EXPANSION JOINT IN EVERY PANEL

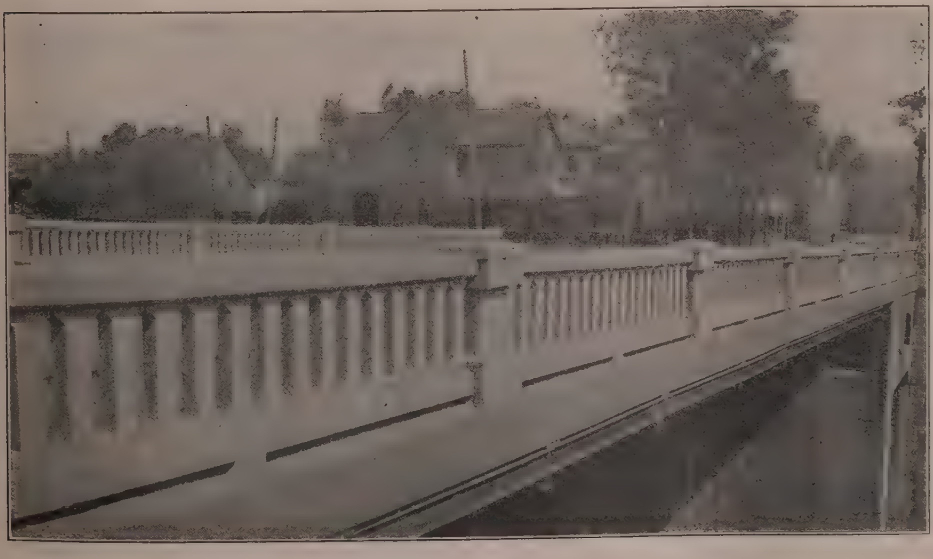
The panels between the hollow posts are usually 20 ft. long, but vary from 10 to 22 ft. The bottom rail rests on blocks 3 in. above the floor to give a detached appearance. Both rails extend into the post beyond the post shell. Projecting reinforcing rods in the rails entering from the high side bond with the green concrete subsequently filled into the posts, but an expansion joint has been secured on the opposite and lower side of the post by wrapping the rail ends in tar paper.

A basket reinforcement of four ¼-in. rods wrapped with No. 2 wire cloth has been provided for the post shells, which are covered with a cap held down by a wire embedded in the cap during its construction. This wire was forced down into the soft concrete after the shell was filled.

Separate members were cast near the slab plant used to construct the large units for the subways, as described in the Engineering Record of Aug. 30, 1913, page 288. A pug mill, steam house and gantry crane comprised the equipment. The pug mill was used to obtain uniformity of mixture, as mortar in it could be observed and the foreman was relied upon to obtain the proper consistency. Wood forms were employed to prevent craze and sand marks. In cold weather the steam house facilitated setting, while in summer 45 min. in the steam retarded setting a sufficient amount to avoid crazing. The aggregate consisted of 1 part cement, 2½ parts Kaw River sand, considered exceptionally good, and 1 part of crusher-run soft native limestone passing a ¾-in. mesh. All measurements were made by hand in a 1-cu. ft. box.



WOODEN LIFTING LINK FOR RAILS



TYPICAL UNIT BUILT HANDRAIL ON KANSAS CITY VIADUCT

The rails were turned upon a sand cushion twenty-four hours after being poured. The posts were cast at three separate pourings so that shrinkage would not crack them at the points of top and bottom enlargement.

RATE OF PROGRESS

During the first three months, with twenty trained men and foreman, 60 lin. ft. of rail per day were completed, but by introducing factory methods of keeping the men at the same duties day after day, the identical crew doubled its output by the time the work was finished.

For distances 1½ mi. and less from the plant the pieces were transported by team in a specially built padded wagon. For longer stretches flat cars were commissioned and the castings raised to the viaduct decks by a small hand-operated A-frame derrick mounted on a four-wheel truck. Later the erection was carried out with the same derrick. In picking up the rails a link of timber was secured to the bag-protected rope hitches near the third points. Ice-tong grab hooks were also employed instead of the ropes. A foreman and six men averaged about 100 ft. per day, but the rate varied 100 per cent.

John V. Hanna is chief engineer of the Kansas City Terminal Railway and A. C. Everham is assistant chief engineer. G. E. Tebbetts, bridge engineer, designed and supervised the handrail construction, which was carried out by the Horton Concrete Construction Company, of Kansas City.

THE EXTRACTION OF GASOLINE FROM NATURAL GAS, according to a bulletin issued by the U. S. Geological Survey, has become one of the chief adjuncts of the natural gas industry in the United States. The production in 1913 was almost double that in 1912.

End Supports of Lachine Bridge Spans

Pedestals Are Supported at Expansion Ends on Nests of Segmental Rollers with Special Interlocking and Protection

THE four 1300-ton single-track 408-ft. spans of the Canadian Pacific Railway Bridge across the St. Lawrence River, at Lachine, Quebec, the reconstruction of which was described in the Engineering Record of Jan. 21, 1911, page 84, and that of April 5, 1913, page 380, have riveted trusses with the reinforced ends of the lower chords seated on cast-steel shoes pin-connected to pedestals which, at the expansion end, are supported on nests of segmental rollers with special interlocking and protection.

Both shoe and pedestal have full-length half-hole bearings on 10-in. steel pins 25 in. long, grooved in the center to interlock with ribs in the bearings. The pedestal takes bearing between planed guide ribs on a riveted bedplate reinforced on the under side to engage the rollers. The rollers are inclosed in a tight channel-iron frame that thoroughly protects them from dust or disturbance, and they rest on a heavy reinforced bedplate which, like the upper bearing plate, has a longitudinal center guide rib engaging a notch in the rollers, and is accurately machined on all of the bearing surfaces. The upper and lower plates of the frame are bolted together and connected to the structural steel supports by vertical bolts passing through slotted holes in the upper plate to permit movement relative to the other members.

The rollers are of the usual segmental type except that the two end rollers have projecting from both ends trunnions which engage vertical bars having top and bottom cycloidal teeth registering with slots in the bedplates, thus controlling the movement of the segmental rollers and affording a simple method of maintaining them always in their correct relative positions. At the fixed end of the bridge the roller bearings are omitted and the lower pedestal is seated on a grillage of I-beams connected by top and bottom countersunk riveted bedplates and by a diaphragm of horizontal, longitudinal angles riveted to their webs and riveted together through their overlapping flanges.

This plan of support was designed by P. B. Motley, bridge engineer, and has been adopted for many important structures. For the Lachine Bridge it was fabricated by the Dominion Bridge Company, of Montreal.

Tests Controlling Sewage Plant Operation

Committee of American Public Health Association Makes Progress Report on Analytical Methods at Jacksonville Meeting

ALTHOUGH the latest edition of "Standard Methods of Water Analysis" of the American Public Health Association supplies sanitary engineers, chemists and bacteriologists with a nearly complete set of analytical procedures—many of which are of assistance to sewage works operators—it does not state which of the many tests described are most useful for the practical purpose of sewage works operations. To meet this need the association's committee on sewage works operation and analytical methods, consisting of W. L. Stevenson, chairman; Prof. Geo. C. Whipple, Langdon Pearse, H. C. McRae, and C. B. Hoover, submitted at the recent annual convention in Jacksonville, Fla., a report recommending certain tests and commenting upon their relative value. An abstract of this report follows:

Composite samples of sewers, both crude and treated, are preferable to single samples. On account of the variable character of the sewage, individual samples are often unreliable. Crude sewage should be sampled at more frequent intervals than effluents from refined processes of treatment.

TESTS RECOMMENDED

The committee recommends that the following tests be made, although it points out that this portion of its report should be regarded as suggestive rather than a specification for every condition.

Test X.—A test, designated as test X, is recommended for measuring by incubation the avidity of the sample of sewage or effluent for dissolved oxygen or its equivalent. This test is considered to be of prime importance.

Test Y.—By test Y is meant one for measuring not only the amount but also the condition and physical characteristics of the suspended matter in sewage. None of the existing methods furnishes information concerning the size, physical condition or other characteristics which are so important in the preliminary treatment of sewage. Analysts are urged to devise a technique to supply the information desired.

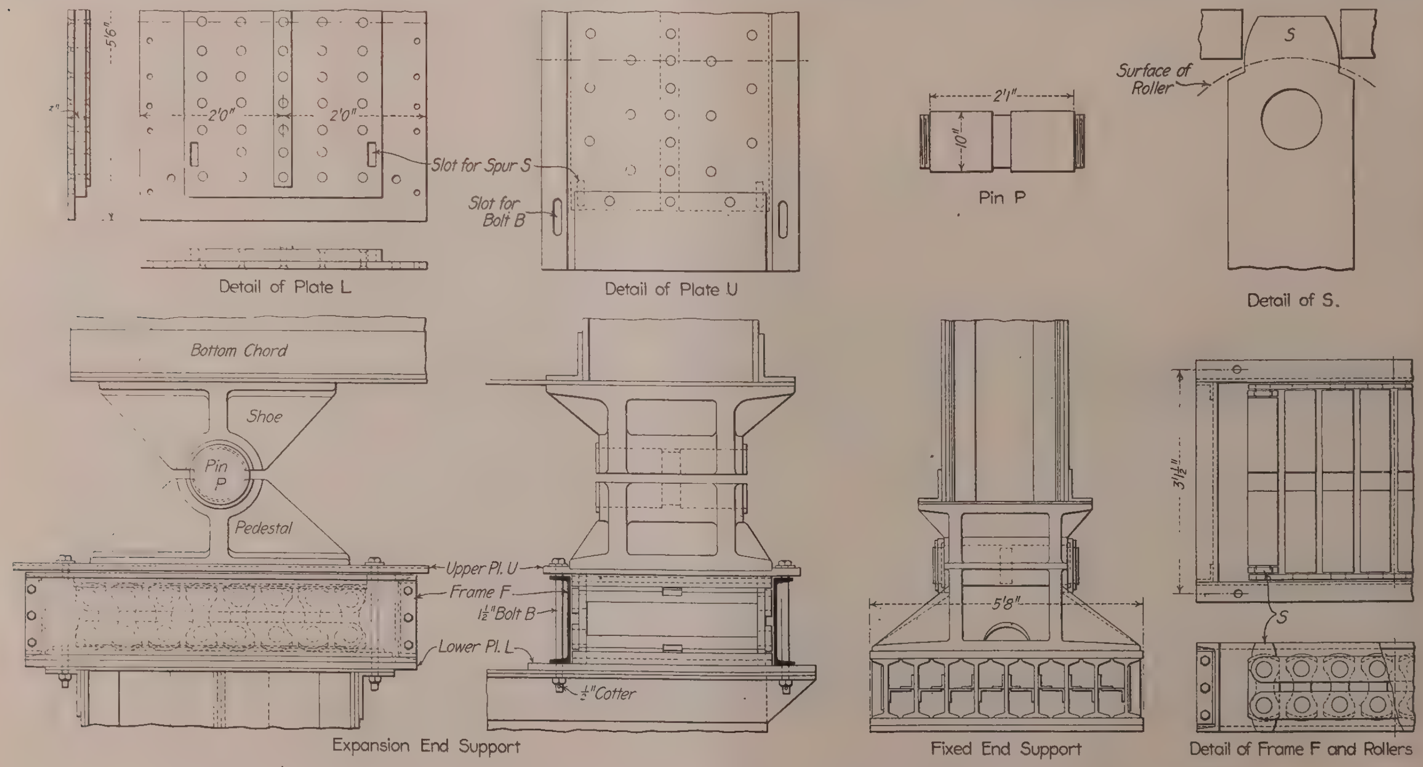
Nitrates.—The nitrate test is useful because it is a delicate indicator of the activity and efficiency of oxidation processes.

Dissolved Oxygen.—The dissolved oxygen test is of value because of the light it throws on the condition of the receiving body of water. Its use is recommended also in connection with effluents from oxidation processes. It should be considered in connection either with test X or relative stability.

Relative Stability.—The methylene blue test has a definite value in connection with the dissolved oxygen and nitrate tests in explaining the records of past operation, but its greatest value is as a control for small works. Its daily use is recommended in preference to occasional tests of other kinds.

TESTS OF SLUDGE

The following tests for sludge are recommended: Specify gravity, percentage moisture, percentage of the dry residue that is volatile, and reaction (alkalinity or acidity). These tests interpret the biological digestion of organic matter and are of great value in sewage works operations. The reaction test is particularly important as an aid in detecting the cause of and pointing out the remedy for poor sludge production. It has been found that tanks producing bad



Detail of Plate L

Detail of Plate U

Detail of S.

Expansion End Support

Fixed End Support

Detail of Frame F and Rollers

DETAILS OF EXPANSION AND FIXED END SUPPORTS OF SPANS IN ST. LAWRENCE RIVER BRIDGE AT LACHINE sludge can be made to operate satisfactorily by adjusting the reaction from acid to alkaline.

Bacteria.—For sewage treatment works intended solely to prevent nuisance in water courses tests for bacteria are superfluous. They are, however, of the utmost importance in cases where the works are intended to protect sources of water supply or shellfish layings. But it is unnecessary to carry on the confirmatory tests for B. coli used in waterworks control, as the presumptive tests are much simpler and more conservative.

Crude Sewage.—The following tests are recommended for crude sewage. Suspended matter (test Y), avidity for oxygen (test X), nitrogen as organic, nitrogen as free ammonia, and chlorine.

The committee of the American Public Health Association hopes to submit a final report on sewage works operation and analytical methods next year.

Book Reviews

The New York Public Library has issued a 7 x 10-in., 35-page pamphlet giving a list of works in the library relating to oxy-acetylene welding. The list is surprisingly large in view of the comparatively recent introduction of this method.

"Rapid Earthwork Calculation", by C. E. Housden, late P. W. D., India, is a small 5 x 7¼-in. book embodying improvements in earthwork calculation suggested by a reconsideration of the author's "Practical Earthwork Tables." It contains 31 pages with tables and diagrams. (London, Longmans, Green and Company, 50 cents net.)

The Committee on Field Practice of the National Fire Protection Association has issued an inspection manual called "Field Practice" to distinguish it from an ordinary fire protection handbook, from which it differs radically in function. It is not a mere compilation of fire-protection standards, but a handbook designed to educate and serve the man who is undertaking inspection work, and who, possibly, has had little previous experience. It points out the common faults in equipments and those points of deterioration difficult for inexperienced persons to discover, with methods and suggestions for their remedy. The book will be sent on application to the secretary of the National Fire Protection Association, 87 Milk Street, Boston.

The 1914 year-book of the American Society for Testing Materials has just been issued. It contains 500 6 x 9-in. pages with cloth binding. The first 375 pages relate to the technical work of the society itself. They include standard specifications for fifty-eight products of steel, wrought iron, cast iron and other metals, cement, lime and clay, and miscellaneous materials; recommended practice and provisional methods for various processes; standard tests and methods of testing; standard definitions of road and pavement terms, and a standard classification of structural timber. There are also tentative specifications for cold-drawn steel, quicklime and hydrated lime. Then follow thirty-two pages of specifications selected from the American Railway Engineering Association, the United States Steel Products Company and the Association of American Steel Manufacturers. The remainder of the book is given to the society's affairs—lists of officers and committee membership and various regulations of the society. The book is published by the American Society for Testing Materials and issued from the office of the secretary-treasurer, University of Pennsylvania, Philadelphia.

"The Stone Industry in The United States in 1913" is the title of a separately printed part of the Mineral Resources of the United States comprising pages 1285 to 1410 inclusive. The author is Ernest F. Burchard. The report covers the stone resources of the States west of the Rocky Mountains, including Arizona, California, Idaho, Nevada, Oregon, Utah and Washington and is illustrated by three quarry maps. The maps and text referring to California, Idaho and Utah were prepared by G. F. Loughlin, of the U. S. Geological Survey. The chapter on production is divided into granite, trap rock, marble, limestone and sandstone. Other chapters deal with units of measurement, exports, imports and tariff. At the end of the book there is a survey of publications on stone, slate and road metal.

Text Book of Mechanics, Vol. V—Hydraulics, by Louis A. Martin, Jr., Professor of Mechanics, Stevens Institute of Technology. Cloth, 5 x 7½ in.; 223 pages; 114 figures. New York, John Wiley & Sons. $1.50 net.

(Reviewed by M. L. Enger, Assistant Professor of Theoretical and Applied Mechanics, University of Illinois, Urbana.)

According to the preface "No attempt has been made to include in this text lists of the experimental constants of hydraulics." Except for a few average values, and some coefficients of discharge of weirs, no constants are given. The treatment of the subject is academic. Although the discussion of the flow of water in pipes is very fragmentary and the flow of water in open channels is not considered, six pages are devoted to Boussinesq's theory of the discharge through a rectangular weir with suppressed end contractions. Quoting again from the preface, "Especial attention has been devoted to the principles underlying the theory and the design of impulse wheels and turbines." The treatment, however, is elementary and does not differ materially from the one usually given. There are three hundred problems with answers, and many of these are very good.

The book lacks engineering flavor, and is not as well suited for the use of engineering students as are several other texts now on the market.

Calculus for Engineers. By Ewart S. Andrews and H. Bryon Heywood. Cloth, 4½ x 7 in.; 269 pages; 102 illustrations. London, Scott, Greenwood & Son. 4 shillings net.

The courses in higher mathematics as generally given in many colleges are not well adapted for giving the engineer a working knowledge of the subject. The result is that many students fail to see its application to the practical side of engineering, and few engineers make any use of it at all. Calculus is an efficient tool by which to attack engineering problems, clearly shown by the number of formulas derived by means of it. The authors, of whom one is an engineer and the other a mathematician, have approached each new phase of the subject so that the need of calculus is felt; then its use is explained. The book begins with a few generalities, preparing the reader for the subject, and introducing it to him in such an easy manner that he cannot definitely tell when it commences actually. A direct application of the subject to engineering problems is made all the time, and the authors have proved the benefit of the combination of an engineer with a mathematician in writing such a book. The problems and exercises have been chosen in the fields of civil, mechanical and electrical engineering. The book is a valuable contribution to the available texts for engineers and engineering students. It is not a reference book. It should be carefully studied from cover to cover until the reader becomes as familiar with the use of calculus as he is with addition, subtraction, multiplication and division.

Steam Power Plants and Heating and Ventilation Plants, Part I and Part II Respectively of Power, Heating and Ventilation, in Three Parts, by Charles L. Hubbard, B. S., M. E., Consulting Engineer. Part I, cloth, 6 x 9 in.; 299 pages, 183 illustrations. Part II, cloth, 6 x 9 in.; 308 pages, 207 illustrations. New York, McGraw-Hill Book Company. $2.50 net each.

The two volumes already out comprise the first two volumes of a revised edition of a book that was published by the Technical Press in 1908 and 1909. In the revision, the arrangement has been considerably changed and more matter added, with the result that the subjects treated are more logically grouped in the various volumes than in the earlier edition and are in many cases more complete.

The work throughout deals with the small plant such as would be found in the manufacturing or business section of a community and not with the large central station, and there are many points that well apply to house heating. There are many illustrations of the necessary apparatus, with typical layouts and discussion as to the best type for any case. A large part of the illustrations are from catalogs and much of the matter presented has appeared in papers of the author in various technical journals. The preface states that care has been taken to treat the subject in a simple and concise manner and that sufficient space has been devoted to the derivation of formulæ and to the principles involved in the various methods of procedure to make the work of much value to both the student and practical engineer. The author has succeeded well in carrying out this idea and as far as it goes the work is well written and in such a manner as would appeal to a large number of readers who are not experts in the subjects treated.

Twenty-fifth Annual Report on the Statistics of Railways in the United States for the Year Ended June 30, 1912. Prepared by the Division of Statistics, Interstate Commerce Commission. Cloth, 9 x 11½ in., 719 pages. Washington, Government Printing Office. $1. (10 cents for the 65 pages of text.)

This report is similar in form to the report for 1911. The first 65 pages comprise the text proper, which contains forty-seven tables, with discussion thereof. Section A, which follows, gives abstracts of the reports rendered by the steam railways, which are divided into three groups according to earning power. Part I of this section deals with roads having annual operating revenues above $1,000,000. The abstract includes the condensed balance-sheet statement, income account and profit and loss account; operating revenues; operating statistics; equipment in service; miles of tracks; details of investment other than road and equipment; of marketable securities; of cash and securities in sinking and redemption funds, insurance and other reserve funds, and provident funds; capital stocks and funded debt on June 30, 1912. Part II embraces the roads with annual operating revenues from $100,000 to $1,000,000; the particulars given are mainly the same as for Part I. Part III covers the roads with annual operating revenues below $100,000. The particulars given are miles of road and some statistics pertaining to balance sheet, operating revenues, operating expenses and income account.

Section B contains an abstract of reports rendered by lessor steam railways, giving particulars similar to those given under Part I, Section A. Section C contains a table showing the single-track mileage and intercorporate relation of steam railways. Appendix A gives similar information for switching and terminal railways, and Appendix B gives a condensed balance-sheet statement of such companies.

Steel Construction. A Text and Reference Book Covering the Design of Steel Framework for Buildings. By Henry Jackson Burt, Structural Engineer for Holabird and Roche, Architects. Leather, 372 pages; 215 illustrations. Chicago, American Technical Society.

(Reviewed by F. H. Constant, Professor of Civil Engineering, Princeton University, Princeton, N. J.)

This book is intended to cover the detail of steel construction for buildings of an architectural nature. It does not include mill buildings nor roof trusses. Although published in handbook form and containing many useful tables for the designer, it enters quite considerably into theory and in this sense has many of the characteristics of a textbook.

The book is divided into five parts, although there is nothing in the table of contents to indicate such a partition. Part I, covering 73 pages, is introductory and descriptive of the methods of manufacture of steel, the properties of rolled sections, the quality of material, standard specifications, unit stresses, rivets and bolts. Part II, with about 100 pages, includes beams and plate girders. Some of the elementary principles of flexure are reviewed. A table giving reactions and maximum bending moments in beams for thirty cases of different end supports or loading likely to occur in practice will be found useful to the designer. Plate girders receive scientific treatment. The author prefers the more exact moment-of-inertia method, although the relation of the approximate, or "chord" method to it is pointed out.

Part III, with 100 pages, covers columns, tension members and wind bracing. The effect of eccentric loading is emphasized. The author would recognize the greater efficiency of columns with solid webs by decreasing the working stress for other types. Five tables enable the designer to obtain unit stresses and safe loads for various columns.

The subject of wind bracing, covering thirty pages, is taken up rather fully. After discussing the methods of transmission of wind load from roof to foundation, the stress analysis for triangular and portal frameworks in buildings with two or more horizontal panels and any number of vertical stories is considered. In the portal type it is customary to start with some sort of approximate assumptions, which, of course, are never actually realized. In the present work the horizontal shear in any story is assumed to be equally distributed between all of the columns (counting the two outside columns as one), the points of contraflexure are taken at the midpoints of columns and girders, and the vertical axial stress occasioned by the overturning moment of the wind is assumed to occur only in the outside columns. The manner in which this last is to be computed is not very clearly stated (page 255), although it may be inferred from the case of two horizontal panels with diagonal bracing (page 244). In effect it assumes all of the horizontal panels to act as independent bents so that the cumulative vertical tension and compression in an interior column from adjacent panels of equal width will exactly neutralize each other. More reasonable assumptions have been made by other designers and authors for the solution of this multiple portal problem, which the reviewer believes lead to more accurate results. The author's method has the merit of extreme simplicity and uniformity of results.

Part IV, 64 pages, takes up the practical design of a 16-story fireproof hotel (the Fort Dearborn Hotel, of Chicago). Many plates showing floor plans, elevations, foundations and framing details are given, followed by computations of loads, floor and column design, wind bracing, pedestals and other important details.

Part V, 40 pages, discusses the theory of rust formation, the properties of paint and methods of fire protection. The book closes with a standard specification for structural steel buildings which embodies the principles previously set forth in the text.

The book is amply illustrated by cuts and numerical examples, while many unsolved problems scattered throughout the text afford the student means for testing his knowledge. It contains many useful tables and necessary data, which, together with the clear and amply illustrated exposition of theory, should make the book a valuable adjunct both in the design room of the college and in the office of the practising engineer. The book is of pocket size with flexible leather cover, and the typographical work is excellent.

Letters to the Editor

A Question of Society Ethics

SIR: The editorial entitled "A Position Restated," appearing in your issue of Nov. 14, very considerably modifies the position taken by you in your editorials entitled "A Question of Society Ethics" and "Societies and Specifications" which appeared in your issue of Oct. 17. You now refuse to discuss the specifications, which you formerly asserted were drawn up in the interests of clients of mine, but you still maintain that the American Society of Municipal Improvements laid itself open to criticism by placing me at the head of its committee on sheet asphalt specifications because *I am "closely identified with manufacturers of certain types of asphalt."* You also state that the same criticism would apply if the committee had been *"headed by a representative of the lake asphalt interests."* This appears to be capable of only one interpretation: viz., that I am the representative of asphalt interests opposed to the "lake asphalt interests" and for that reason am not properly eligible for the position of chairman of a committee on sheet asphalt specifications.

I wish to deny absolutely that I am "closely identified with manufacturers of a certain type of asphalt." As consulting engineers more than half the business of my firm is done with municipalities. In this work we deal with and supervise the use of "lake asphalts" as well as all other asphalts and our only endeavor is to produce the very best results irrespective of the asphalt used. We also do work for contractors and manufacturers, testing their products, advising them as to methods of manufacture, and, when we judge it proper to do so, appearing for them in court and at hearings. We have done work of this kind for practically every manufacturer of asphalt in the United States, including all the "lake asphalt interests," and cannot on this score, therefore, be said to represent any one group to the exclusion of any other group.

While our position as to the relative merits of different kinds of asphalts and the desirability from the municipal standpoint of open specifications and free competition has remained unchanged for the past seven years (ever since our firm was established), it is, nevertheless, true that during the past two years we have done but comparatively little work for the Barber Asphalt Paving Company.

Broadly speaking, there are only two types of asphalt used for paving work in this country; viz., the so-called "lake asphalts" and those manufactured from asphaltic petroleum. I have never urged the use of any one of these types to the exclusion of the other type and have always urged specifications admitting both types on a ground of equality.

I am not in any sense the representative of any manufacturer or group of manufacturers nor am I retained by any manufacturer or group of manufacturers to influence, directly or indirectly, the use or sale of any of their products. I have no interest, direct or indirect, in the sale or use of any product or products of any kind whatever.

Unless, therefore, you are prepared to assert that all consulting engineers are ineligible to the position of chairman of specifications committees (in which case our most prominent and able city engineers would also be ineligible), I maintain that the whole foundation for your editorials falls to the ground and you owe both the American Society of Municipal Improvements and myself an apology for printing them and that this apology should be accorded the same prominence as was given to your editorials.

In spite of the statements of Messrs. Compton, Kleeberg and myself that the specifications adopted this year were the joint work of the whole committee, you have not retracted the statement contained in your first editorial that the chairman and one other active member made the report. You also fail to state why you consider that the present A. S. M. I. specifications unduly favor the oil asphalt interests.

Our business depends upon our honesty, fairness and impartiality and you have gone out of your way to attack it and to injure it by statements and innuendoes which we are prepared to prove are absolutely false, and these have been published by you without the slightest effort on your part to ascertain the true facts in the case.

New York. FRANCIS P. SMITH.

[The above communication was sworn to by Mr. Smith.

The engineering Record believes that the A. S. M. I. specifications favor certain asphalt interests because, although under the wording of the specifications there is no discrimination, when they are used the lowest-priced material, without regard to quality, so long as the material is within the wide limits of the specifications, will with very rare exceptions be taken.

Regarding the statement, in the editorial entitled "A Question of Society Ethics" that the chairman of the committee and one active member made the report, the Engineering Record accepts the statements of Messrs. Smith, Compton and Kleeberg, in the issue of Nov. 14, that the report was the joint work of the committee, and regrets very much that it stated otherwise.

As to Mr. Smith's statement that he is not the representative of any manufacturer or group of manufacturers, the Engineering Record emphasizes again that it did not impute any improper motives or actions to him or to the committeemen in question. It used the word representative in the editorial entitled "A Position Restated," in the sense that the services of the gentleman in question, as far as advising manufacturers are concerned, have in recent years been confined chiefly to different manufacturers of one particular type of asphalt. Mr. Smith states that his services to manufacturers constitute less than half of his entire business.—Editor.]

Principles of Valuation

SIR: I have read with appreciation an editorial in your issue of Nov. 28, page 577, containing kind remarks about my paper before the American Society of Civil Engineers on the "Fundamental Principles of Public Utility Valuation," and I also note with interest your frank expression of your disagreement with certain principles therein set forth. Two of these points of disagreement relate to engineering and economic questions, which are subsidiary to the main thought of the paper, and I will not attempt here to discuss them, but your attitude as to the authority of the law and its interpretation by the courts seems to me profitably to call for some comment.

There is no doubt at all but that in the numerous engineering and economic details which the courts are compelled to pass upon in valuation matters they sometimes go astray. This is not unnatural, and the wonder is, with such a vast array of technical details presented to them and so little time at their disposal, they do as well as they do. But with the fundamental principles of the law as regards property, its protection and its treatment, the higher courts do not swerve, so far as my observation goes, from a consistent path which is fundamentally derived from our Constitution.

Obviously the Constitution of the United States is not a subject for effective review by engineers as such, nor does it seem to me really good taste for a profession like ours, desirous as it is for wider recognition, to belittle the work of another great profession, especially in the underlying principles of its own individual field. The law governing the right to hold property and its protection in this country is fundamentally the product of many generations of precedent and practical experience as well as thought and study on the part of minds that have given this branch of knowledge special attention. This experience has been finally crystallized into the fundamental concepts of our Constitution, and the interpretation of these principles by the higher courts is, to my mind, cautious, conservative and worthy of the utmost deference on the part of engineers.

So fundamental is the conception of the right to hold property and its proper protection to our civilization that thinking men are agreed that if the loose views which have of late years been thoughtlessly put out on this subject should prevail, our present civilization would be seriously imperiled, if it did not vanish. It is vitally necessary that engineers should recognize this fact, and it is further right and proper that they should recognize that the law in its own domain is not properly subject to thoughtless suggestions for revision, or even criticism, unless they have given the science of the law at least intelligent study. If you will pardon my plain speaking, nothing seems to me to be more provincial than this constant suggestion from engineers that valuation work is a matter entirely within their own domain, and that if there is anything in the law that interferes with their ideas of property the law must be changed. This is, in effect, denying that the basic law of this country is in any way entitled to respect, or that the precedents of many generations of experience with mutual rights, crystallized into our basic law, are fundamentally sound. Not even the Congress of the United States or the Legislatures of our States can change the fundamental attitude of the people of this country toward property as expressed in our various constitutions; and the attitude which some commissions and appraisers have recently taken in assuming that private property devoted to the public use, having its income and use regulated, is in any way altered in its inherent nature from the status of ordinary private property, or is restricted in its rights to protection, natural growth or inherent decline, is a fallacious one, and will have to be abandoned whenever presented to the courts, for they are clear and consistent in their interpretation of the law on this point.

It is true that legislation might provide laws that would operate in future cases to contract with capital to be invested in the public service so that it would be protected as a restricted investment only, and assured a fair return. But would this be a safe or sane policy? A moment's reflection would convince any thoughtful man that the perpetual guarantee of capital by the State is a dangerous and fallacious idea, leading inevitably to the destruction of all incentive to economy by the investor, and involving the State and the public, in many cases, to the support of useless or obsolete investments. There is no middle course that is just and practicable between protecting the investment in this manner and the view of the law as to its character as a property, fluctuating as a whole and taking the ordinary economic chances of life as a whole. Now, a great deal of the loose criticism of the fundamental law and the interpretation of the fundamental law by the higher courts along these lines is, to my mind, regrettable in a profession that above all others should be quick to appreciate where its own limitations of knowledge end, and where other fields of knowledge begin.

I think a careful reading of that part of my paper bearing on this part of the subject will show that I have not spared the courts where they can be justly criticised. I may further add that I was fortunate in having the paper passed upon before publication by several eminent attorneys skilled in valuation matters, who kindly gave me the benefit of their judgment and criticism.

Chicago. JOHN W. ALVORD.

"Specification Fiends"

SIR: The recent publication of an abstract of an address delivered by R. W. Sherman, chief engineer of the New York State Conservation Commission (see the Engineering Record of Nov. 28, page 595), calls to mind some of the work of the specification fiend and pinfeather engineer that has recently come under the observation of the writer. A contractor had secured the contract to build a dam. The specification was very elaborate in detail and among other things stated that "the vertical members of the framing supporting the concrete forms should be of good, straight-grained spruce or hemlock, 3 x 6 in. and of convenient length." The contractor had on hand, for another purpose, timber answering to the specification except that it was 3 x 8 in. He proposed to use this for his formwork. The pinfeather engineer, acting for his superior, forbade this as not conforming to the specification. Is it any wonder that this contractor threw a mild kind of fit? Strange to say, the chief engineer sustained his subordinate.

Another contractor was building a concrete forebay to carry water to a series of waterwheels. The specification called for this to be 18 ft. in clear width. From some reason, probably the springing of the forms, this forebay, when completed, was for about 35 ft. of its length only 17 ft. 11¾ in. in clear width. The supervising engineer obliged the contractor to bush hammer an area of about 500 sq. ft. to bring it to the specified width.

A third contractor was laying a line of 24 in. water pipe. The specification stated that it must be in line and to the grade laid out by the engineer. The pipe, or about 900 ft. of it, had been installed, and under the supervision of the engineer's personal representative, when the engineer appeared on the scene, set up a transit and discovered that this line of pipe deviated from a straight line about ⅜ in. The contractor was obliged to re-adjust the pipe and re-calk all disturbed joints. This engineer was one of those who never took a drink, smoked, chewed or told a story. Is it any wonder that contractors shy from such men?

Still another contractor was planking a roof where the specification called for two 5-in. spikes on each timber. He had a quantity of 6-in. spikes that he desired to use up. Could he use them? No sir, most decidedly not—the specification called for 5-in. spikes and they must be used!

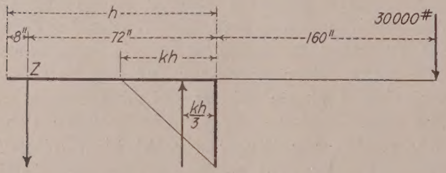
I have had nearly fifty years experience with contractors and in my younger days was probably as big a fool as the average young engineer, but I desire to say that with few exceptions I have found contractors ready and willing to use common sense in their operations, and further, as a rule, have found them honest. As a matter of fact I have learned more from contractors than I ever did from books. It seems to me that it would be greatly to the advantage of the young engineers, if more of the old heads would write common-sense, blue-blooded articles, similar to those of Mr. Sherman. Like the famous goat, many of them have great persistency but mighty poor judgment.

An Old Engineer.

Anchoring Base Plates for Columns

Sir: I was interested in the article "Anchoring Base Plates for Columns" in the issue of Oct. 17, page 441, and the editorial on it. It is rather a broad statement that the prevailing method of figuring stresses is incorrect, giving values from 12 to 50 per cent too small. It seems hardly possible that an engineer of good standing would figure the stresses as cited in the given case; that is, figure the maximum compression by the formula for a homogeneous material, and the stress in the anchor bolts by taking moments about the edge of the masonry plate.

A few years ago the writer designed the columns and anchorage of a rather important structure, where the bending to be taken care of at the column base was large, the resultant coming considerably outside of the base plate. The section of the masonry under the base plate was considered as a section of a reinforced-concrete arch ring with the pressure line outside of the ring, and the stresses were obtained by the usual formulæ for combined flexure and direct stress.



From these formulæ the stresses for the example given in the above-mentioned article work out as follows, the results agreeing with those obtained by Diplom-Ingenieur Wendt, of Berlin, in the "Zentralblatt der Bauverwaltung" of Aug. 26: Given length of base plate 80 in., width 40 in., $a = 8$ in., $R = 30{,}000$ lb., area of bolts $A = 5.758$ sq. in. and $n = 15$. The formulæ I used were

$$f_s = nf_c[(d/kh) - 1] \quad (1)$$

and

$$R = \tfrac{1}{2}f_c bkh - f_s A \quad (2)$$

Substituting the given values

$$f_s = 15f_c[(72/80k) - 1]$$

and

$$30{,}000 = 1600f_c k - 5.758f_s$$

Taking moments about z,

$$1600f_c k[72 - (80k/3)] = 6{,}960{,}000 \quad (3)$$

or

$$115{,}200f_c k - 42{,}667f_c k^2 = 6{,}960{,}000 \quad (3a)$$

From equation (1),

$$f_s = (1600f_c k - 30{,}000)/5.758$$

and from equation (2),

$$f_s = (13.5f_c/k) - 15f_c$$

Equating,

$$1600f_c k^2 + 86.37f_c k - 30{,}000k = 77.73f_c \quad (4)$$

Dividing equation (3a) by 26 2/3 it becomes

$$-1600f_c k^2 + 4325f_c k = 261{,}200 \quad (5)$$

Adding equations (4) and (5)

$$4411f_c k - 30{,}000k = 77.73f_c + 261{,}200$$

from which

$$f_c = (30{,}000k + 261{,}200)/(4411k - 77.73) \quad (3b)$$

Substituting the value of f_c in equation (3a) it becomes

$$k + 12.6k^2 + 2.1k^3 = 0.887$$

Solved by trial, $k = 0.225$. Substituting in equation (3b), $f_c = 293$ lb. per square inch and in equation (1) $f_s = 13{,}200$ lb. per square inch.

E. F. Allbright.

Wollaston, Mass.

Sheerboards versus Summit Pools in Hydraulic Dam Construction

Sir: In your issue of Sept. 12, 1914, page 286, appears an editorial entitled "Sheerboards versus Summit Pools in Hydraulic Dam Construction," which comments on my article, in the same issue, on page 288, on the Westover Terrace Project in Portland, Ore. In this editorial, referring to the construction of a dam without the use of a summit pool, the following statements are made: (1) That "the clay particles carried by the water are likely to be completely wasted with this method and that a bank thus built will probably not be tight," (2) that "if a really tight dam is desired, it remains to be proved that this method of construction, without summit pool and without core, and with an almost complete loss of the contained clay, can be used," and (3) that "the use of a summit pool will probably always be necessary where clay is to be handled and, in fact, was for that reason compulsory on part of the Portland work for a fill at an elevation above the gravel deposits."

Conditions prevalent at different dam sites are of course not all similar and construction details will vary at each one, depending on the character of material, flume grades and so forth, and a general statement of what can be done is not possible before an examination of the site. However, the fundamental difference between the present method of hydraulic-fill dam construction and the method proposed, that is, without the use of a summit pool, is that with the new method the entire mass of the dam will be made impermeable, rather than merely the central portion of it. This would be accomplished by filling the voids in the heavier material as the earth is deposited and not segregating the fine particles from the heavier lumps. The attempt on many dams to secure a symmetrical core of impermeable material through the central third of the structure is not realized on account of the constant and uneven encroaching of the heavy outer portion of the dam on the unstable central portion, during construction, with the attendant crushing and bulging of the soft saturated material. This increasing weight and crushing due to the superimposed weight is constantly breaking up and distorting the saturated material in the center. If the impermeable core could be placed and left undisturbed as it is put in position by the water, with the application of the weight of the superimposed heavy material evenly distributed to squeeze out the contained water, the condition of impermeability and stability in the central portion could be accomplished—but this is not possible.

It is true that a somewhat greater percentage of the clay particles may be lost by the elimination of the summit pool, and of course this loss would have to be controlled so that enough of the fine material could be retained to fill completely all of the voids in the porous material and make an impermeable bank. When the voids have been completely filled the suspended clay particles may better be carried outside the structure than left on it. Depositing of the material could start at one end of the dam and the filling be brought to grade as the work progresses, except in the case of an extremely high dam, where it would be necessary to bring the embankment up in several courses. In the actual construction it will probably be expedient, in some cases, to maintain a small pool on the summit to act as a circulating basin, in order to take as much as possible of the load from the water before it is discharged. This pool, however, would in no case be as extensive as is used in ordinary practice and would not be used for the purpose of collecting the fine clay particles in one position on the dam. The loss of material could also be controlled by regulating the slope or grade of the rising embankment parallel to the axis of the dam. The percentage of material carried off by the water depends greatly on the weight of the material selected for the dam, but in any case this loss can be controlled so that it is at a minimum.

By taking the discharge water off through timber spillways located at convenient points over the slopes of the dam, the operations can be localized, and the process of drainage of the structure can be hastened by keeping the water off from a great portion of the top of the rising embankment.

Contrary to the inference gained from the editorial, it is not the plan to eliminate the corewall by this method, as there are undoubtedly numerous cases where character of material and foundation conditions will necessitate the use of a corewall of one type or another.

Referring to the third statement, it should be explained that the use of the summit pool on the Portland work referred to here was necessary on account of several conditions imposed which were peculiar to this piece of work only. Every yard of earth available for sluicing above the fill had to be held in order to complete the embankment, the material was a light yellow clay of fine texture and without lumps, the area covered by the fill was small, and the work was being done with a plant capable of handling from 4000 to 5000 cu. yd. of material per twenty-four hours. It is plainly evident that the rapidity with which the fill was being made compared with the small quantity had much to do with the difficulty encountered here, and the reason for the small summit pool is certainly not one which would apply to usual construction without these unparallel conditions.

With the proposed method of construction the material in the dam is placed in a homogeneous mass of equal consistency throughout the structure, stratification is avoided, drainage is farther advanced at the time of completion, and unequal settlement, which occurs when there is a central section of fine clay, is eliminated. With the use of sheerboards the slopes of the dam can be carried up on true grade and alignment, and without the use of teams and scrapers for the retaining levees.

Ralph M. Overstreet.

Aberdeen, Wash.

Rainfall on the Island of Hawaii varies from 20 in. per year on some of the slopes of Hualalai to 353 in. in the upper Waipio Valley, according to a bulletin of the U. S. Geological Survey.

Report on Flood Prevention in China

American Engineers Recommend for Huai River Conservancy District a $30,000,000 Project which Will Take 6 Years to Complete

TO reduce the appalling loss of life and damage to property by floods in the Huai River district in China a $30,000,000 river improvement project, which will require 6 years to complete, has been recommended by the board of American engineers, consisting of William L. Sibert, Daniel W. Mead and Arthur P. Davis, appointed by the American National Red Cross in accordance with an arrangement with the Republic of China.

The Huai River conservancy area, according to a report which has just been issued by the board of engineers, is divided into two parts, separated by the old channel of the Yellow River. The river's drainage basin lies in the southern half of the great plain of eastern China. This plain occupies a semicircular area 600 miles in radius. The great disasters caused by the Yellow River in the past, which have given it the name of "China's Sorrow," and which are still a menace to the great plain of China, are largely the result of the fight which has been going on for centuries between the Yellow River, which is carrying on the development of a normal delta plain under abnormal conditions, and the Chinese people, who have attempted for four thousand years or more to confine this stream within limited bounds in order that they may cultivate as much as possible of the great plain of eastern China and support thereby a comparatively dense population.

RAINFALL

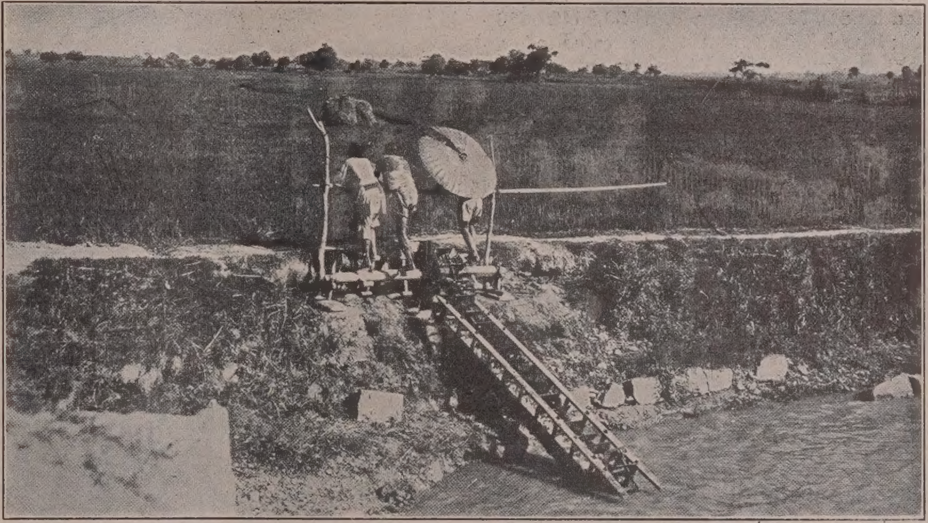
The drainage is so defective as not to offer relief for even the average conditions of rainfall that occur in this region. The torrential character of the rainfall that frequently occurs in this area necessarily results in flood conditions which cause great losses and serious famines in the affected areas. Thousands of lives have been lost by drowning and much property has been destroyed. Even greater loss of life has ensued from starvation in the resulting famines, and millions have been spent even to partially mitigate the distress occasioned. While the average rainfall is about 36 in. per annum, the minimum rainfall locally is not more than one-third of this amount, and the maximum may be quite 80 in. A local rainfall of 25 in. fell in 48 hours 10 miles north of Pengpu in August, 1910. Fortunately such rainfalls are unusual, but rainfalls of from 4 to 8 in. in from one to three days are quite common and result in floods more or less serious according to the condition and extent of area over which they occur.

FLOOD DISCHARGES

While the board has not had opportunity to make a direct measurement of the maximum floor discharge of the Huai River, which drains an area of 50,000 sq. miles above Pengpu, it has had measured the discharge of that stream at Pengpu at stages between low water and an 18-ft. stage. The low-water discharge was 4000 sec.-ft. and the discharge with a rise of 18 ft. was 84,815 sec.-ft. The river sometimes rises 10 ft. above that stage, thus making variations between extreme high and low water about 28 ft. The maximum flood discharge of the Huai at Pengpu, estimated from measurements taken and from calculations based upon known high-water marks at Pengpu and a point 8 miles up stream, plus the roughly estimated discharge of the small streams entering the Hungtse Lake and the Huai below Pengpu, leads the board to conclude that the maximum amount of water entering the Hungtse Lake is at least 200,000 sec.-ft.

PROJECT RECOMMENDED

All projects previously proposed for improving flood conditions in the Huai River have contemplated either sending all the water east to the sea, preferably by the bed of the old Yellow River, or a portion of it to the sea by that route and the remainder south to the Yangste through the lakes to the west of the Grand Canal. The board of engineers is of the opinion that it is best not to attempt to divide the waters of the Huai, and that all such waters should go, as they have for the last sixty years, into the Yangtse River near Chinkiang; that such waters should be diverted into Paoying and Kaoyu lakes in such a way as to make entirely feasible the reclamation of the bed of Hungtse Lake. This reclamation of the Hungtse Lake bed makes it practicable to construct a channel across the same with high dikes, through which can be safely passed to Paoying Lake the waters of the Sui and the drainage water from a large part of the territory annually flooded, bounded by Hungtse Lake, the old Yellow River bed, the Tientsin-Pukow Railway, and the Huai River below Pengpu.



CHINA IS STILL EMPLOYING PRIMITIVE METHODS OF IRRIGATION

By the plan recommended it is proposed to build a suitable dike from the left bank of the mouth of the Huai River opposite Kweishan, to the village of Tsiangkiapa, roughly parallel to the shore of the Laotzeshan Peninsula, and everywhere at least 3 kilometers therefrom. This will form with the shore line a channel for the diversion of the Huai River from Hungtse Lake, which with the proposed excavation will be capable of carrying about 200,000 sec.-ft. of water at lake stage of 13 m., and disposing of ordinary floods of 100,000 sec.-ft. without permitting the water at Kweishan to rise more than 12 m. above sea-level.

With a slope of 0.00005 between Laotseshan and Tsiangkiapa, the accompanying table shows roughly the discharge capacity of this channel at various elevations of the Huai River at Kweishan.

DISCHARGE CAPACITY OF HUAI DIVERSION CHANNEL

Stages of river	Discharge in cubic feet per second
11 meters above sea level	30,000
12 meters above sea level	100,000
13 meters above sea level	200,000
14 meters above sea level	340,000

It is proposed to build regulating works at the Tsiangkiapa outlet, with a capacity of 200,000 sec.-ft. with water surface just above the works 12 m. above sea-level; to provide a channel below Tsiangkiapa with a discharge capacity of 200,000 sec.-ft. to Kaoyu Lake, with the lake at a stage 8 m. above sea-level; and a channel from that lake to the Yangtse having the same capacity, with the river at 19 ft. on the Chinkiang gage.

It is proposed to provide the unwatered bed of Hungtse Lake with an extensive network of canals and laterals, with beds about 3 m. below the surface of the ground. The outlets of the principal drains would be provided with controlling works, so that the channels would serve for drainage when left open, and by closing them the canals would be filled from the Huai River and used for irrigation by means of moderate lifts varying from 1 to 6 or 7 ft., according to their distance from the source of supply. This system would also be available for navigation, and would connect with the Grand Canal and thus make available the waters of the Huai River for navigation in that canal, and for irrigation east of it when needed.

REGULATING LOCKS

The enlarged channel capacity to be provided between the Kaoyu Lake and the Yangtse would in dry weather empty that lake, and, unless prevented, so deplete the waters of the Grand Canal as to destroy navigation and deprive the lands east of it of irrigation water. To prevent this, and to improve navigation it is proposed to build a lift lock in the Grand Canal near the town of Shaopo, with a total lift under extreme conditions of about 4 m, and a channel with lock and regulating works connecting the Grand Canal above this lock with the channel leading to Sinnemiao.

The region to be chiefly benefited is the area bounded on the north by the old bed of the Yellow River, on the east by this old bed and the Ming Dike; on the south by the southern margin of Hungtse Lake and the Huai River; and on the west by the Tientsin-Pukow Railway. The upper Huai River and its tributary valleys will be but slightly affected by the proposed works.

Substantial benefits will also accrue to the agricultural land east of the Grand Canal, which was this year and is frequently inundated by the excess water from the Grand Canal, and is as often short of irrigation water. Both these conditions will be removed by the proposed works, and all the country served by the Grand Canal will benefit by the improved navigation.

The Chinese Government should agree to apply the entire tax on the reclaimed land and any increase in taxation on the benefited land to the payment of the bond interest and principal. This should net not less than the following amounts: Reclaimed land, 386,000 acres, at $1, $386,000; benefited land, 7,000,000 acres, at $0.25, $1,750,000; total, $2,136,000. The value of reclaimed lands in two districts and of benefits in three districts totals $48,350,000.

There should be received annually at the end of the six-year period of construction from the revenues of the Grand Canal and other canals in the area a net return of $225,000; from taxes on land, $2,136,000; or a total of $2,361,000.

COST OF PROJECT

The works recommended are estimated to cost about $30,000,000, U. S. currency. They can be economically completed within about six years after the beginning of construction, provided funds are available as needed, and the work is vigorously prosecuted. If the bonds issued bear 5 per cent interest, and are sold at 90 cents on the dollar, and if 3 per cent can be secured on unexpended balances, the total issue to cover discount and interest during a 6-year construction period will amount to $45,000,000.

On the basis of the benefits estimated above and the returns from canal tolls and the taxes suggested it is believed by the board of engineers that a satisfactory method for financing the project can be devised.

The board does not recommend a percentage contract. Much of the work can be more economically done by contracts for work of a specified character. There is no incentive for speed or economy when the contractor receives a specified per cent of the actual cost, and the chief engineer under such an arrangement is practically powerless to secure either. Should a contract be let for the entire work or a large part thereof, it should be let either on a unit price basis or for actual cost plus a specified amount. In the latter case the contract should also provide that if the contractor shall show inability or lack of due diligence in securing economy of construction or shall attempt to secure other than the specified profit the contract shall be nullified.

MOVING PICTURES PORTRAYING ENGINEERING CONSTRUCTION in actual progress formed one of the features of a meeting held by the Western Society of Engineers Dec. 7. The pictures were shown in two reels, one devoted to highway construction and the other to the manufacture of concrete fence posts, tile and silos.

Automatic Drawbridge Signal

Electric Device for Indicating by Means of a Red and a Green Light, Position of End Lifting Mechanism While Bridge Is Swinging

ACCIDENTS and delay to traffic may occur on swing bridges because of the improper position of the end lifting mechanism when the ends of the span approach the rest piers. This mechanism is remote from and invisible to the operator, who ordinarily depends on his memory and adherence to the routine succession of operation, assisted perhaps by bell signals. This has not always been found efficient and satisfactory, and in order to supplement or replace the usual indicators and provide a positive and constant indication of the position of the lifting mechanism a device has been designed and constructed by Jacob Harsen, who is in charge of the operation of the Willis Avenue bridge in New York City.

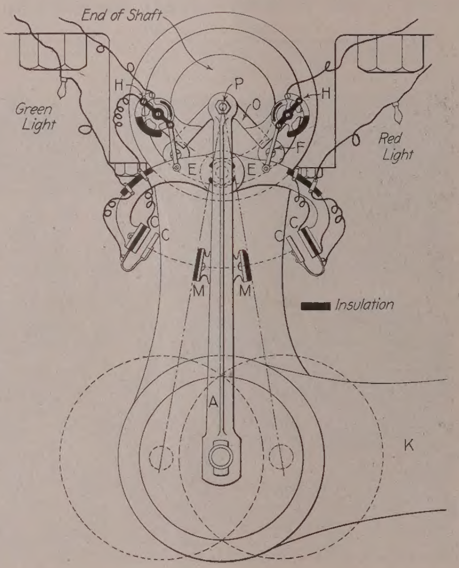


DIAGRAM SHOWING MECHANISM

The device is attached to the side of the journal shaft which operates the link controlling the lifting toggles. It is actuated by the movement of the link, and is set so that when the lift is in normal condition no lights show, but when the toggle movement begins a red light appears to the operator and continues to shine until the movement is completed far enough for the support to clear in swinging. It is then replaced by a green light, which remains until the movement is completed and the bearings are made. The green light in turn then disappears, after which no lights are visible until the bridge is again operated. The device is adjustable so that either light can be made to appear or disappear at any desired position of the mechanism.

OPERATION

A fixed support is rigidly attached at any convenient place and carrys a swinging arm *A* (see the illustration) pivoted to it at *P*, which is concentric with but entirely independent of the driving shaft. It also carries two contact quadrants *H* and a pivoted crosshead with two arms *EE* terminating in swing contact pieces *CC*. When the operation of the lifting mechanism is begun the main link *K* moves to the right and causes the arm *A* to swing correspondingly until the insulated shoulder *M* forces the two contact pieces *CC* into engagement and completes the circuit from the quadrant *H*, lighting the red lamp, which continues lighted until the farther movement of the arm *A* carrying with it the arm *E* operates the link *F* to revolve the radial contact arm around the quadrant from the conducting surface to the insulated surface, thus breaking the circuit and putting out the lamp. As soon as the movement on the lever arm is reversed the link is reversed, the contact at *CC* is broken and the subsequent operation of the link *F* cannot alone relight the lamp.

Exactly similar operations are effected by the movement of the link *K* and the arm *A* to the left, lighting and extinguishing the green lamp. Thus each lamp shines during a fixed period of the operation of the mechanism and neither of them does when the arm *A* is in the vertical position. The device has been in satisfactory operation for several months.

Labor Laws Passed in 1914

Some of the Federal, State and Territorial Enactments of the Year, as Listed by the American Association for Labor Legislation

FEDERAL, State and Territorial labor laws passed during 1914 are listed in a bulletin issued by the American Association for Labor Legislation. New workmen's compensation laws were enacted in New York, Maryland, Kentucky and Louisiana, while other States, notably Massachusetts, extended the provisions of existing compensation codes. Measures for the prevention of compressed-air illness and of lead poisoning were passed in New Jersey. In seven States measures affecting labor were submitted to popular vote. Among these are a new Arkansas child-labor law and a Washington bill prohibiting the taking of fees by private employment agencies from applicants for work. The 1913 Colorado "assumption of risk" law and the Nebraska workmen's compensation act of the same date, upon which referenda had been demanded, were sustained by popular vote, while the Missouri full-crew law of 1913, which was similarly challenged, was repealed. Universal eight-hour day bills, initiated in the three Pacific Coast States, were defeated.

EXEMPTION FROM SHERMAN LAW

A section of the new Federal anti-trust law prevents the use of the Sherman act against trade unions on the ground that "the labor of a human being is not commodity or article of commerce." Congress also strictly regulated the issuance of injunctions by Federal courts in labor disputes, and established an eight-hour day for female workers in the District of Columbia. Two measures still before Congress provide for a Federal system of public employment offices and for adequate industrial accident and occupational disease compensation for Federal employees.

Three legislatures enacted laws requiring the reporting of industrial accidents or occupational diseases. Four States gave further attention to protecting their industrial workers from fire. Three States and the Territory of Alaska legislated on the subject of safety in mines, Kentucky going furthest and enacting a new mine code. Several new railroad laws are concerned with full crews, headlights and enclosed vestibules on trolley cars.